THE DENTAL PRACTITIONER

AND DENTAL RECORD

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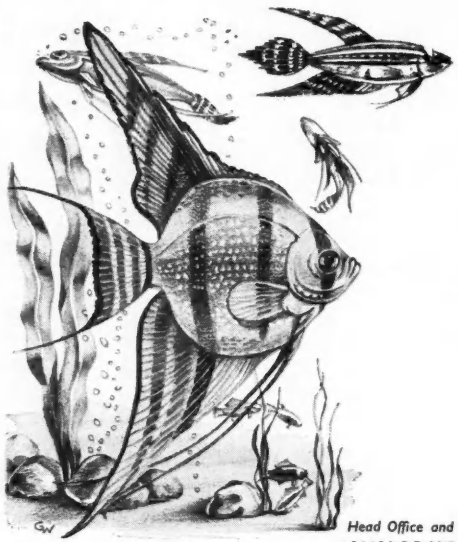

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THE DENTAL PRACTITIONER AND DENTAL RECORD

Vol. X, No. 3 November, 1959

EDITORIAL

DENTAL ANÆSTHETICS—WHAT NOW?

RECENTLY an article in a national newspaper professed to report the views expressed in a responsible paper published by a medical journal. As is unhappily not unknown in such cases, the effect of the extract was quite different from that intended by the author of the original article. Its message could have undoubtedly caused fear and alarm among those readers about to receive dental treatment under general anæsthesia.

It was stated that more than a score of fatalities occurred among the three million anæsthetics given in the dental chair each year—the chief hazard being anoxia. However, the facts are quite different, and even differ from those given in the original paper. If the number of general anæsthetics administered in the school dental services is included, it is probable that the total is nearer three and a half million. Examination of the official documents concerning deaths in 1957 shows that four, not twenty, deaths occurred in dental surgeries. At little more than one death per million general anæsthetics, the British dental profession can surely be proud of a remarkable record of safety!

Nevertheless, despite this high standard, strenuous efforts are needed to maintain and further improve it. No national standard of training in anæsthesia is yet laid down for either the dental or medical student; and the undergraduate training is usually left to the teaching staff concerned. On the other hand, the responsibilities of general anæsthetic administration suggest that it may more suitably be a postgraduate subject. Whichever; the lack of adequate training or of suitable postgraduate facilities, is real, and gives one to wonder at the remarkable safety factor—at least from death—which is at present achieved.

The best welfare of the patient demands that the best available skill shall be employed in anæsthetic administration, whether by anæsthetist, medical practitioner, or dental practitioner. The ideal would be a skilled anæsthetist present at every minor anæsthesia. Such an ideal is not practical in view of the relatively few qualified anæsthetists. Therefore, any steps which can be taken to make anæsthetics even safer and less unpleasant are worthwhile.

This country, with its tradition of pioneering in medicine and surgery, should play its part in this work. Let us hope that all who are interested in the art and science of anæsthetics can work towards complete safety for patients. Safety, not only from the remote possibility of death, but from any possible risk of the hazards connected with any lowering of an adequate intake of oxygen.

THE CONSERVATION OF POST CROWNED INCISORS WITH APICAL ABSCESS

By **B. C. W. BARKER**, B.D.S. (Syd.), H.D.D., R.F.P.S.
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THE treatment of inadequately root-treated and crowned teeth which have developed apical infection presents certain difficulties and it is the purpose of this article to suggest a method whereby such teeth may be restored relatively quickly, easily, and with a minimum of complications.

The problem arises in many cases when, following on a decision to replace an unsatisfactory post crown, the preoperative X-rays reveal a chronic apical abscess which has developed as a result of inadequate root-canal therapy previous to crowning (*Fig.* 1).

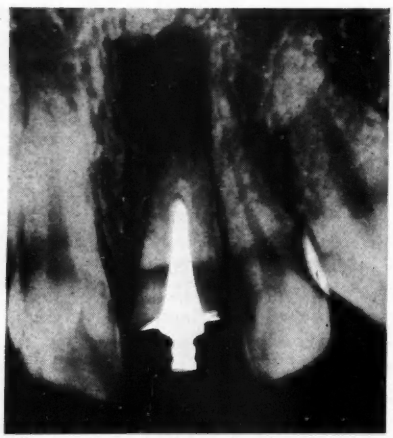

Fig. 1.—X-ray showing a chronic apical abscess complicating the treatment necessary for replacing the unsatisfactory post crown.

In other cases, signs of infection may be apparent—either acute or subacute with recurrent swelling and sinus formation.

In the majority of cases, the tooth may be conserved, provided that the usual indications for extensive conservative work are satisfied.

When considering the treatment plan for the necessary conservative work the following points must be borne in mind:—

1. The necessity, in many cases, for providing further drainage of the apical abscess.

2. The provision of an æsthetic temporary crown during treatment following removal of the existing post crown.

3. The need for eradicating the apical infection and the subsequent sealing of the root-canal.

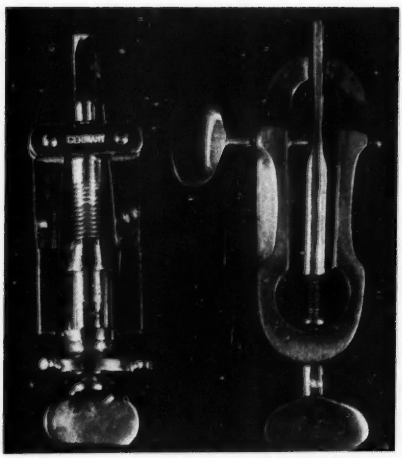

Fig. 2.—Two types of dowel removing instruments. Note the central vice for grasping the dowel, and the lateral stabilizers which rest on the root surface.

4. The fitting of the permanent post crown without disturbing the apical seal in the root-canal.

In the case of an acute exacerbation from such an inadequately root-treated tooth, it is not feasible to attempt any instrumentation on the tooth immediately. Penicillin therapy, perhaps combined with the incision of the abscess, will usually bring the infection under

control within a few days and allow the next procedures to be undertaken.

When there is a sinus present and the inflammation is subacute or chronic, the following procedures are suggested:—

1. *Removal of the Post Crown.*—The acrylic or porcelain crown is broken away leaving the metal post projecting from the root-canal. A dowel removing instrument (*Fig.* 2) is then used to extract the post. This instrument consists of a central vice which is screwed firmly on the post, and a pair of lateral stabilizers which rest on the root face. These counter the force exerted when vice and post are withdrawn incisally by a further screw mechanism.

2. *Preparation of the Root-canal.*—The canal is irrigated with sterile saline or Milton solution (1 per cent sodium hypochlorite, 16·5 per cent sodium chloride), a diagnostic wire or reamer is inserted into the canal and a radiograph taken to ascertain the length of the root-canal. Reaming and filing is then carried out until the canal is adequately enlarged.

The available methods of eradicating the apical infection, obturating the canal, and restoring the crown are as follows:—

a. Gutta-percha points and some form of root sealing paste such as zinc oxide and eugenol or Kerr's root sealer, followed by apicectomy and curettage. The contra-indications to this method are the difficulties of preparing the post hole after apicectomy without disturbing the apical seal.

b. Filling the apical region of the canal with amalgam during the operation of apicectomy *after* amputation of the apex ("retrograde" root filling). This technique is a very useful one, but the packing of the amalgam into the apical portion of the canal from an apical approach sometimes presents real difficulties when we consider the limitations of access and vision.

c. A method which can also be employed is that of filling the apical portion of the canal with amalgam from an oral approach after amputating the apex and while holding a flat plastic instrument over the apical canal.

A method has been proposed employing a matrix consisting of two horizontal metal arms connected by a vertical screw device. The upper arm, which is covered with rubber, is inserted into the wound and covers the apical canal. The lower arm, which is notched, engages the incisal edge. The screw is tightened, thus providing a means of packing amalgam into the apical third, via the oral opening, against a fixed base.

Methods (*b*) and (*c*), however, necessitate further appointments for fitting the cast core.

d. The technique of cementing a cast post and core followed by apicectomy and curettage is presented here as the quickest, easiest, and safest method.

3. *Modification of the Root Face.*—The root-face preparation varies according to the type of crown to be used. If an acrylic post crown with cast core or diaphragm is to be used, then the root face need only be shaped up into labial and lingual facets, perhaps with a central box form to aid resistance. If, however, the more æsthetic cast core porcelain jacket crown is to be constructed, it is essential to create a shoulder on the root face to provide maximum strength in the porcelain jacket against fracture. The modifications shown in *Figs.* 3–5 will allow the core and porcelain crown to be constructed on one set of indirect records, which saves a further appointment.

Labial and lingual facets are defined with an inverted cone stone approximately parallel to, and level with, the crest of the gingiva. Tapering stones and end-cutting burs are then used to shape the shoulder with a width of approximately 1·5 mm., leaving the central core as shown in *Fig.* 2. The shoulder is finished with Black's chisels 34 and 35, and now lies approximately 2 mm. below the gingival crest.

4. *Indirect Impressions.*—The object is to gain an accurate impression of the root-canal as near to the apex as possible, for the cast post must reach the amputated surface after the apicectomy has been carried out. A piece of pink wax is rolled into a cone and inserted into the root-canal. A length of notched stainless steel, or German silver wire, is warmed and inserted into the canal nearly to the apex, leaving approximately $\frac{1}{8}$ in. protruding above the root face. A copper ring is trimmed and

filled with compound and an impression is taken. This impression, which registers the root face and the root-canal, is later copper plated.

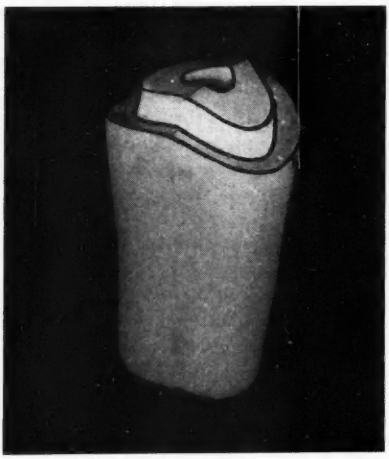

Fig. 3.—Root-face preparation. Shoulder at right angles to the central dentine core.

Fig. 5.—Porcelain jacket crown. The cast core and the crown may be constructed on one set of indirect models.

The localizing impression is preferably taken in Thiokol rubber. A small stock tray is loaded with compound for an impression of the area. A piece of wire is then inserted into the canal

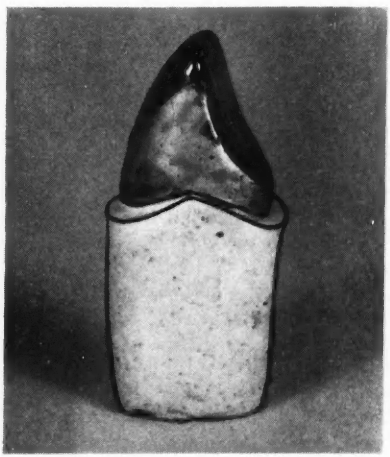

Fig. 4.—Cast post and core in position.

with approximately $\frac{1}{8}$ in. protruding above it. The root-face preparation, which is registered in the compound, is then relieved to allow room for this wire, and the compound is painted with an adhesive. Thiokol rubber is mixed, loaded into the compound impression, and seated into place. After removal a bite recording and a colour plan for the porcelain jacket crown is obtained.

5. *Provision of Temporary Crown and Further Drainage.*—In order to provide an æsthetic temporary crown until apicectomy can be carried out, and also to control the infection by drainage, a method is recommended whereby a temporary acrylic crown is constructed around a wide bore needle or tube inserted into the root-canal. The use of hollow tubes as an aid in root treating crownless upper anterior teeth has been suggested by McGibbon (1956). Ray (1959) further elaborated on the uses of hollow tubes inserted into crownless teeth for providing a suitable projection for the application of the rubber dam and subsequently a temporary plastic crown.

A 2-mm. bore needle, or length of orthodontic tubing, is positioned in the root-canal with approximately $\frac{1}{8}$ in. protruding above the root face. This is temporarily closed with gutta-percha. A cellulose acetate crown form is fashioned to fit the root face, filled with autopolymerizing acrylic of appropriate shade, and placed over the end of the inserted tube. When set, the temporary crown is removed with the tube attached, and a communicating channel to the tube cut with a number 8 round bur from the palatal aspect. The temporary crown with its drainage tube is then inserted with zinc oxide–zinc acetate–eugenol temporary cement (*Fig.* 6).

6. *Cementing the Cast Core and Post and the Apicectomy.*—If time is allowed for the previous steps to be carried out at the first appointment the cast core may be cemented and apicectomy carried out at the second appointment. The temporary crown which has allowed drainage and prevented an acute exacerbation is removed and the canal is irrigated with hydrogen peroxide (20 vols.) and sodium hypochlorite solution. After drying the canal with paper points, the prepared post and core, which has been cast in 18 ct. gold or Pallacast, is cemented with zinc phosphate cement (*Fig.* 7). The porcelain jacket crown is then tried and tested for accurate gingival adaption.

The apicectomy and débridement is then carried out in the usual way (*Fig.* 8). After closing the wound with sutures the permanent porcelain jacket crown is cemented into place and the patient instructed to return in six months in order to check the apical bone regeneration by X-ray examination.

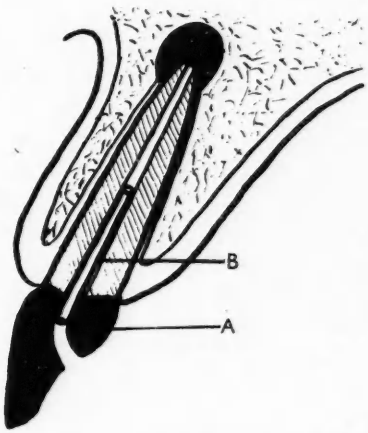

Fig. 6.—Temporary acrylic crown with hollow tube allowing drainage of the apical infection.

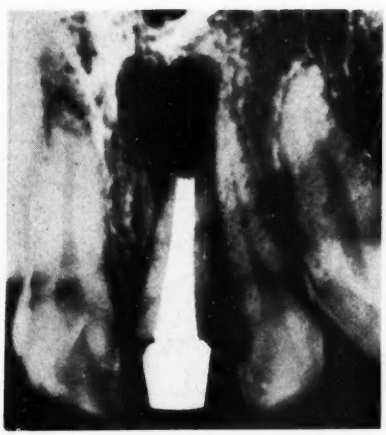

Fig. 7.—X-ray showing the cast post and core cemented previous to apicectomy.

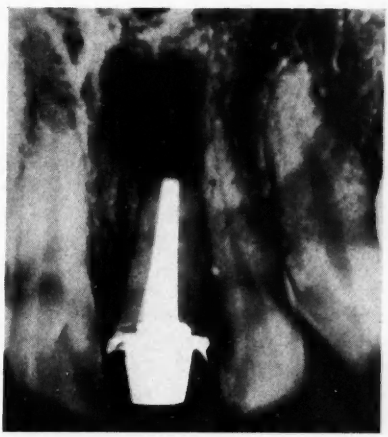

Fig. 8.—X-ray appearance following apicectomy and apical curettage.

It can be seen, therefore, that the conservation of such teeth can be effected in two appointments, provided time is allowed for various stages. An alternative procedure would be to complete the treatment in three appointments, confining the first appointment to the removal of the post crown, the preparation of the root-canal, and the provision of the temporary crown. At the second appointment the root face could be modified and the impressions gained, leaving the final appointment for the apicectomy and the fitting of the crown.

Some operators prefer to make a direct pattern of the post and core. In this case, a longer wire is used not only to support the wax post and core, but also to serve as a sprue. Three appointments would be required, the direct pattern being taken at the first appointment and the casting inserted at the second. After gaining the copper ring impression and the localizing impressions for the jacket crown, the apicectomy is carried out at this, the second appointment, leaving the third appointment for cementation of the crown and removal of the sutures. One disadvantage of this technique, however, is the necessity for making an additional temporary acrylic crown after the insertion of the casting.

SUMMARY

The uses of a hollow-post temporary crown for drainage followed by the fabrication of a cast post and core prior to apicectomy have been suggested in the conservative treatment of inadequately crowned teeth complicated by apical infection.

Acknowledgements.—The author wishes to thank Mr. Shilland of the Photographic Department, Royal Dental Hospital, for his help.

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Ray, G. E. (1959), *Brit. dent. J.*, **106**, 212.

Styloid Syndrome

When diagnosing vague head pains of doubtful aetiology consideration should be given to this syndrome; one which has received scant attention in the literature. The styloid process develops from the second branchial cartilage which extends in fœtal life from the skull to the hyoid bone. The resultant so-called stylohyoid chain consists of four elements: (1) Tympano-hyal or petrous part; (2) Stylo-hyal or body of the process; (3) Cerato-hyal—stylohyoid ligament; (4) Hypohyal—lesser cornu of hyoid bone.

Normally the styloid process consists of the tympano-hyal and the stylo-hyal. Sometimes there may be continued growth and ossification of the branchial (Reichert's) cartilage, which results in an abnormally long (perhaps 6 cm. against 2 cm.) process or ossification of the whole stylohyoid chain.

Of the four cranial nerves involved in the syndrome the most common is the 9th, the 5th occasionally, and rarely the 7th and the 10th. A simple explanation for the cause of the pain is that the mucosa is irritated when drawn over the elongated and pointed styloid process during mastication or when the mouth is opened widely. Elongated styloids may elicit pain, but not all cases of abnormally large styloids necessarily demonstrate a pain syndrome. The condition is more prevalent in males and after the third decade. Symptoms might include any of the following: dull pain in the pharynx, dysphagia or gagging, and increased salivation. There may be disturbed taste, earache, and generalized head pains.

The syndrome is to be differentiated from glossopharyngeal neuralgia, sphenopalatine neuralgia, T.M. joint disturbances, and impacted teeth. Apart from history-taking and radiographs the diagnosis is to include a careful digital examination of the tonsillar fossa of the affected side. The treatment involves simple surgery if the cause is an elongated process, and intermaxillary fixation is cited as the treatment if the cause is fracture of the process.—Donohue, W. B. (1959), *J. Canad. dent. Ass.*, **25**, 283.

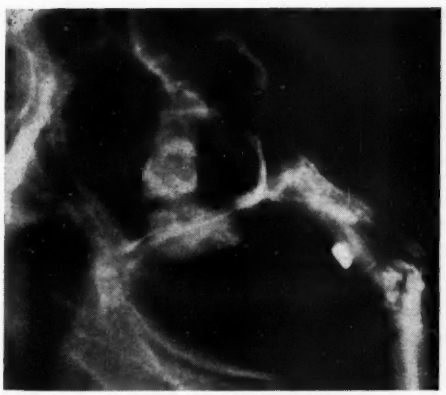
FACIAL PAIN OF UNUSUAL DENTAL ORIGIN

By IAN H. HESLOP, M.B., B.S., B.D.S., F.D.S. R.C.S.
Manchester

IT is relatively uncommon for a completely unerupted tooth to cause pain. When pain for which there is no other apparent cause is complained of in the jaws or face in the presence of an unerupted tooth, that tooth will almost always be found to have connexion with the oral cavity. This connexion allows infection of the pericoronal tissues to occur and may also enable a carious process to start in the buried tooth. Both these factors can account for pain, which may be severe.

CASE REPORT

HISTORY.—The patient, a woman of 33 years of age, complained of pain in the left upper jaw and face, which had recently been accompanied by a foul nasal discharge. The pain had been almost constant for a year with only short periods of relief. She had seen her doctor, dentist, and a number of specialists before the presence of a buried tooth was discovered on a skull X-ray.



A

B

Fig. 2.—A, Lateral jaw film; B, Occipitomental film. The odontome and unerupted $\underline{|8}$ may be seen.

The pain was of a dull aching character and was situated in the $\underline{|78}$ area, making the wearing of the partial upper denture uncomfortable. There was pain also over the left cheek, the side of the nose, inner canthus, and forehead.

The foul nasal discharge, which she had noticed for a month on the left side, was superimposed upon bilateral nasal catarrh of many years' standing.

CLINICAL EXAMINATION.—The remaining teeth in the upper jaw, $\underline{321|3}$, were sound as were the lower teeth. The alveolar ridge in the $\underline{|4-8}$ area was a little enlarged, but otherwise normal in appearance. There was no sinus or discharge or inflammation. The $\underline{|78}$ area was slightly tender to firm pressure.

X-RAY EXAMINATION.—The intra-oral X-ray (*Fig.* 1) showed a radiopaque mass in $\underline{|78}$ region, which had the appearance of a composite odontome. A true left lateral

Fig. 1.—Intra-oral radiograph $\underline{|6-8}$ showing part of odontome.

film and an occipitomental film showed the presence of a large unerupted molar tooth lying above the odontome and apparently situated in the antrum (*Fig.* 2).

AT OPERATION.—Under general anæsthesia, a buccal mucoperiosteal flap was raised in continuity with a Caldwell Luc incision. The flap was reflected upwards, and bone overlying the odontome was removed with a chisel. The odontome was elevated from its bed in two portions. Bone was then removed above this area, making a window in the lateral wall of the antrum in the

region of the zygomatic buttress. Through this space the $\underline{|8}$ was visible, and it was elevated. A few polypi were removed from the antrum.

An inferior nasal antrostomy was then performed and a rubber drainage-tube inserted, with one end in the antrum and the other projecting from the left nostril. The oral wound was closed.

Post-operative progress was uneventful, the drainage-tube being removed after 48 hours. Follow-up showed that the pain and foul discharge had been cured.

Fig. 3.—The tooth and odontome.

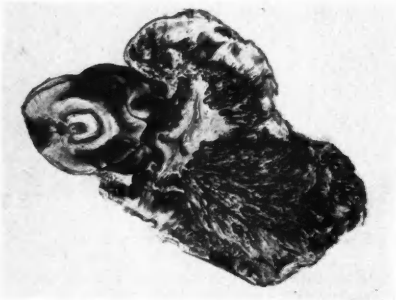


Fig. 5.—Ground section of odontome. (× 15.)

SPECIMEN.—

The Tooth.—This was an upper third molar of about normal size and normal in appearance except for the roots which had become bulbous and distorted due to the irregular deposition of cementum (*Figs.* 3, 4).

The Odontome.—This was a compound composite odontome having a large denticle at one end and several smaller denticles elsewhere. The main mass was composed of mixed dental tissue with a varying degree of organization. Some tubular dentine may be seen (*Fig.* 5).

Fig. 4.—X-ray of tooth and odontome.

SUMMARY

The above case was thought to be of interest on four counts.

1. A tooth, completely unerupted in the mouth, was apparently the cause of a facial pain, which had been extensively investigated before its dental origin was suspected.

2. A large composite odontome was preventing the eruption of the tooth. The odontome was also completely sealed from the mouth.

3. The roots of the tooth exhibited a marked degree of hypercementosis.

4. The pain was accompanied by a foul nasal discharge.

The questions we must ask are: "Was the tooth in contact with the antral cavity? Was there in fact a pericoronitis on this buried tooth, discharging into the antral cavity and thence into the nose? Was it a suppurative pericoronitis which explained the foul nasal discharge and the facial pain?"

It seems reasonable to suppose that the answer to all of these questions is in the affirmative.

AN ANALYSIS OF THE COMMONEST CAUSES OF FULL DENTURE FAILURE

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INTRODUCTION

In most dental practices the majority of full denture patients are well satisfied with their prostheses, but there is frequently a small percentage of patients who are persistently seeking adjustments and whose dentures are far from successful. In these patients the well-known sequence of ease, reline, remake, ease, reline . . . is repeated in a never ending cycle.

In order to determine the commonest causes of these denture failures, 200 such patients have been carefully examined and detailed records kept. In each case the dentures were examined objectively and assessed in accordance with specific criteria. Two examiners participated in the investigation.

METHOD OF ASSESSMENT

For the sake of convenience the factors examined were divided into three groups, namely: (1) Retention; (2) Jaw relations; and (3) Unstabilizing factors. The criteria by which each of these factors was judged were as follows:—

1. Retention.—This may be defined as the attachment of the fitting surface of the denture to the epithelium of the adjacent mucous membrane.

It is assumed that a correctly retained base should cover the greatest possible surface area of supporting tissues. It is also assumed that the entire border of the denture should be placed upon soft displaceable tissue if retention is to be developed and that:—

a. In the labial and buccal vestibule, the border should at least reach the junction of alveolar mucosa and labial or buccal mucosa.

b. The posterior palatal border should reach displaceable tissue posterior to the hard palate.

c. The posterior border of the lower denture base should cross the *soft* tissue on the posterior part of the retromolar pad.

d. The posterior lingual border should be extended down to the floor of the mouth.

e. The anterior lingual border should be extended backwards as far as the sublingual fold when the tongue is at rest.

f. The posterior buccal border should reach the external oblique ridge.

2. Jaw Relations.—This group has been further subdivided into the two components—vertical and horizontal.

a. Vertical Dimension.—It is assumed that there should be at least 3 mm. of free-way space.

b. Horizontal Component.—This really involves only an anteroposterior position, as a lateral movement is simply a forward movement of one side of the mandible. The upper and lower teeth should meet in centric occlusion when the mandible is in its most retruded unstrained position.

3. Unstabilizing Factors.—This group includes certain factors which, if neglected, may predispose towards displacing the dentures in relation to the supporting alveolar bone.

Occlusions should be balanced in left and right lateral and protrusive positions.

Articulation should be unobstructed in all movements from one occlusion to another with the teeth in contact.

The Occlusal Plane of the lower denture should be below the greatest convexity of the sides of the tongue when the tongue is in its usual resting position.

Neutral Zone.—The teeth should be placed in a position of equilibrium between the forces developed from activity of buccal and lingual musculature.

The Contour of Muscular (*i.e., Polished*) *Surfaces* should be shaped so as to resolve muscular forces into stabilizing ones.

* This article is based upon work carried out in the Department of Prosthetic Dentistry, Institute of Dental Surgery, Eastman Dental Hospital, London.

RESULTS*

1. Retention.—		
Faults in Base		
Upper		
Under-extension:	Anterior border	76
	Tuberosities	166
	Posterior border	112
Over-extension:	Anterior border	1
	Tuberosities	0
	Posterior border	0
Lower		
Under-extension:	Retromolar pad	182
	Posterior lingual	180
	Anterior lingual	182
	Posterior buccal	155
Over-extension:	Retromolar pad	1
	Posterior lingual	0
	Anterior lingual	0
	Posterior buccal	1
2. Jaw Relations.—		
Occlusal vertical dimension:	Too great	89
	Too small	27
Anteroposterior:	Mandible too anterior	55
	Mandible too posterior	8
3. Unstabilizing Factors.—		
Eccentric occlusions		
Lack of blance in:	Left lateral	122
	Right lateral	125
	Protrusive	107
Articulation:	Obstructed	107
†Occlusal plane:		
Upper:	Too high	11
	Too low	12
Lower:	Too high	69
	Too low	4
Neutral Zone		
Upper: Anterior teeth:	Too labial	1
	Too palatal	141
Posterior teeth:	Too buccal	1
	Too lingual	47
Lower: Anterior teeth:	Too labial	0
	Too lingual	57
Posterior teeth:	Too buccal	0
	Too lingual	104
Contour of muscular surfaces incorrect:		
Upper: Palatal		23
Buccal and labial		41
Lower: Lingual		19
Buccal and labial		21

CONCLUSIONS AND DISCUSSION

The commonest errors, in order of frequency, in these 200 patients are:—

1. Under-extension of bases: e.g., Retromolar pad, 91 per cent; Maxillary tuberosities, 83 per cent; Posterior border of palate, 56 per cent.

Very few of the dentures utilized more than a small fraction of the supporting area available. In many cases the area covered could have been more than doubled. Most standard impression trays need considerable adaptation and extension by suitable material before they can possibly carry the impression material to the required position. Those areas of the tray most commonly in need of such extension are over the retromolar pads, in the tuberosity sulcus, and at the posterior palatal margin.

2. Upper anterior teeth placed too far back: 70 per cent.

Setting the upper anterior teeth on the crest of the residual alveolar ridge still appears to be widely practised, apparently with the mistaken idea that this is necessary for denture stability. In reality, this posterior setting restricts the space available for the tongue which consequently tends to displace the denture forwards, interferes with speech, and fails to provide adequate support to the musculature of the upper lip, thus resulting in a very unsatisfactory appearance. In addition, the amount of overjet is reduced, thus making freedom of articulation practically impossible.

The upper anterior teeth should normally occupy the same labio-lingual position as their natural predecessors. To achieve this the central incisors should normally be set with their labial surfaces about 1 cm. in front of the centre of the incisive papilla.

3. Unbalanced occlusion: 62 per cent.

4. Obstructed articulation: 53 per cent.

Free sliding movements of opposing occlusal surfaces were most frequently prevented by the overbite being too great in relation to the overjet. Protrusive movements were prevented chiefly by the incisor teeth-setting, and lateral excursions by the canines and first premolars.

5. Lower molars placed too far lingually: 52 per cent.

The attempt to avoid unfavourable leverages by placing the lower molar teeth on the crest of the residual alveolar ridge frequently results in a restriction of tongue space and is completely nullified by the consequent displacement of the denture by the tongue.

* The figures listed indicate the number of dentures which were faulty in each respect.

† The apparent discrepancy between the figures for occlusal planes of upper and lower dentures is due to errors in the vertical dimensions of the dentures.

6. Increased vertical dimension: 44½ per cent.

The symptoms of increased vertical dimension are practically pathognomonic and a diagnosis can almost be made over the telephone. The patient complains of indeterminate pains involving both upper and lower jaws generally. The discomfort increases markedly as the day passes and is associated with a feeling of tiredness of the jaws. Shooting pains may develop around the temporal, frontal, and zygomatic regions. Usually the patient is obliged to remove one or both dentures by mid-afternoon or immediately after work, when the symptoms very rapidly disappear and relief is obtained. The dentures seem quite comfortable again the following morning, but the same symptoms gradually develop once more. No ulceration is present and eating is not unduly painful.

This condition is easily avoided by ensuring that there is an adequate amount of free way space. Usually 3 mm. is sufficient.

7. Lower occlusal plane too high: 34 per cent.

One of the functions of the tongue during mastication is to place the bolus of food on the occlusal surface of the lower teeth in preparation for the next chewing stroke. If the occlusal surface is too high for the tongue to reach comfortably, the tongue will rapidly displace the lower denture by exerting its lateral thrust against the lower posterior teeth instead of against the bolus in the space between upper and lower teeth.

8. Centric occlusion does not coincide with the most retruded position of the mandible: 31 per cent.

A true recording of the correct anteroposterior jaw relationship is frequently very difficult to obtain and small errors may be very difficult to detect clinically. Even a small error, however, will result in undesirable horizontal thrusts on both denture bases with consequent pain, damage to supporting tissues, and tendency to displace the dentures.

An interesting fact emerging from this investigation is that although so many faults were present in these dentures the dental surgeons who referred the patients for examination had apparently been unable to detect them. It is hoped that a sequence of investigations such as that outlined above will assist practitioners in making a diagnosis of the cause of full denture failures.

SUMMARY

1. This paper presents an analysis of those faults most commonly found to be present in unsuccessful full dentures.

2. The criteria by which the dentures are judged are first specified and the findings of the examinations are then tabulated.

3. The commonest faults are discussed with the purpose of assisting the practitioner to avoid them.

4. The paper offers to the practitioner a logical sequence of investigations whereby he will be enabled to diagnose the causes of full denture failures.

UNDERGRADUATE PRIZE

An annual prize of £15 is offered by the British Society of Periodontology for an essay by an undergraduate dental student (who has not obtained a registerable dental qualification at the date of submission of his entry) in a Dental School in Great Britain.

This year the subject is "The Value of Radiology in the Diagnosis of Periodontal Disease". The essay, which should be typewritten and not exceed 4000 words, may be accompanied by photographs, drawings, or original radiographs strictly necessary to illustrate the text. The undergraduate's name should not appear on any part of the paper.

A special committee of the Society will judge the essays, which must be received by the Honorary Secretary before March 31, 1960. All communications should be addressed to: P. J. Hill, Hon. Secretary, British Society of Periodontology, Flat 47, Montague Mansions, London, W.1.

SILICIOUS DEPOSITS IN THE ORAL SOFT TISSUES OF INDUSTRIAL WORKERS*

By **E. C. FOX**, M.D. (Vienna), L.D.S. (Edin.), and
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INTRODUCTION

It was suggested that prevention of oral disease should be the theme underlying the papers to be given at the meetings of the British Society of Periodontology in the session 1958–9. For some years we have been interested in the possible presence of deposits of silica in the soft tissues of the oral cavity, and as our contribution to this year's work we considered an investigation into this problem might be of value from the point of view of prevention. In particular, we were anxious to study the incidence of silicious foreign material in the oral tissues of workers in those industries in which there is a high percentage of pneumoconiosis.

The literature on lesions due to silicious material in the oral soft tissues is not extensive. Shattock (1917) seems to have been the first to describe a lesion, which developed as a swelling in the lower lip 10 years after a road accident. He considered the lesion to be a pseudo-tuberculoma silicoticum, but the value of his paper is reduced to some extent by the fact that the reproduction of his microscopical findings was, by to-day's standards, inadequate. Giant cells and giant cell systems containing large numbers of transparent, angular, colourless particles were described. This foreign material was shown to be insoluble in strong nitric and hydrochloric acids and, according to Shattock, thus proved to be silica. No radiographs were taken prior to surgical removal of the diseased tissue. The knowledge of silicosis and sarcoidosis in those days was not very advanced, and he was not able to offer any explanation of the fact that birefringent particles were also present in the submental glands but had not caused any form of foreign body reaction. In his consideration of differential diagnosis he mentioned the possibility of the lesion being due to powdered glass, but did not furnish any chemical or spectographic evidence to support this.

Kramer (1951) reviewed the literature on silicious granulomatosis and described the presence of foreign body lesions containing birefringent material in 6 out of 149 specimens of gingival tissue removed during gingivectomy. He was not, however, able to relate the presence of silica to any particular factor, and did not comment on the occupations of those patients in whom deposits were found. Marsland and Fox (1955) reported a persistent ulceration of the oral soft tissues associated with the presence of silica in one patient, but again no convincing evidence was put forward as to how the crystals had got into the tissues. Epstein (1955) recorded a silicious granuloma affecting the cheek, which was apparently caused by glass forced into the skin as a result of a motor accident 10 years earlier. He reviewed the literature and quoted a total of 22 cases of foreign body reactions in the skin due to silica. Practically all of these developed after accidents of one sort or another. The crystals which were present in the tissues in his own patient gave the characteristic birefringent reaction of silica, although glass identical to that which he believed had caused the lesion was not doubly refractile when examined under polarized light. Epstein suggested that this difference in optical property might have been due to the fact that the glass present in the tissues was hydrolysed or attacked in some way by tissue fluids, and silicon dioxide in crystalline form was deposited in the tissues where it caused a foreign body reaction of the sarcoid type. It is significant that Epstein discussed such causative agents as war injuries, athletic injuries, road accidents,

* Read at the meeting of the British Society of Periodontology held on March 9, 1959.

and the use of sandpaper therapy in cosmetic surgery, but made no mention of the possible importance of occupation.

Forman and Shuttleworth (1956) in a communication to the Section of Dermatology of the Royal Society of Medicine made a further contribution to the knowledge on this subject by describing a chronic granuloma of the gingiva with associated swelling of the lip in a patient working with sodium silicate solution. Microscopic examination of tissue removed at biopsy showed in the gingiva a typical foreign body reaction with giant cells associated with small areas of calcification, proliferation of fibroblasts, and infiltration by lymphocytes and plasma cells. In the lip only capillary dilatation and a small node of histiocytes with foamy cytoplasm were seen. Microscopical examination of these sections showed birefringent particles in the gingival tissue, but after a section had been heated to 500° C. for one hour and subjected to the action of concentrated hydrochloric acid, particles differing from the original birefringent particles seen in the section were recovered. These were considered to be contaminants from the air or from the walls of the furnace. Forman and Cross (1956) described chronic granulomatosis affecting the alveolar mucosa, the lip, and chin in one patient, but as microscopic examination of the tissues showed only numerous tubercle-like lesions containing Langerhans type giant cells, they were not able to give any definite indication of the pathology. Acid-fast bacilli could not be demonstrated, nor were there any doubly refractile particles suggestive of silica. In spite of these negative findings Forman and Cross made the following tentative suggestions: (1) A silicious granuloma of the gingiva was present, and this, as is well known, had rendered the tissue more liable to tuberculous infection. (2) The whole lesion was due to silica. They pointed out that silica particles may be very small in size and therefore difficult to demonstrate. They also drew attention to the fact that silica may have been present in a colloidal state or even as a solution of sodium silicate and considered that as colloidal silicic acid had been shown to be absorbed along lymphatics, it might in this way have provoked the granuloma of the lip.

Our own interest in the problem of silicious deposits in the oral soft tissues stems from the finding of such deposits in one patient four years ago. At that time the possibility that these deposits might have been due to some occupational factor was considered, and although no convincing relationship could be traced in that particular instance, we were stimulated to go into the problem more thoroughly. In the Midland area there is a high incidence of pneumoconiosis, and the wide variety of industries in which workers are liable to contract the disease affords an opportunity for investigating not only silicosis but also asbestosis, stannosis, and anthracosis. At the present time pneumoconiosis is one of the most serious industrial diseases. The annual report of the Chief Inspector of Factories for 1953 listed well over 20 occupations in which deaths from silicosis were reported although, as is widely known, the highest incidence occurs in coal-miners.

The serious nature of pneumoconiosis was recognized many years ago, and in 1914 a Royal Commission on Metalliferous Mines and Quarries drew attention to the dangers of inhaling dusts containing quartz, quartzite, flint, and sandstone. Mere exposure to atmospheres containing dust is, however, not the only factor involved. The susceptibility of individual workers to the disease is very variable, and while some may develop disabling lesions within a period of three years, others working in the same factory or mine may not show serious lesions until they have been exposed to the causative dusts for periods as long as 15 years. Other workers, despite even longer exposure, never contract the disease. While in general it is true that exposure to atmospheres containing large quantities of dust is more likely to lead to the development of the disease, the findings in some Midland foundries indicate that other factors play a part in determining the onset of the disease. For example, the incidence of pneumoconiosis is higher in workers in certain foundries with a relatively low degree of dust contamination in the atmosphere than it is in those employed

in other foundries in which the dust content in the atmosphere is high (Cole, 1959).

Table I illustrates the incidence of fatal cases of silicosis in pottery workers, coal-miners, and foundry workers for the years 1943, 1948, and 1953, and shows that the incidence of the disease is increasing in all three, although the greatest increase is seen in miners. This table was taken from a more comprehensive table published in the annual report of the Chief Inspector of Factories for 1953 which shows

Table I.—Deaths due to Silicosis in Great Britain.

Occupation	1943	1948	1953
Pottery workers	41	48	79
Foundry workers, including metal grinding	21	26	36
Coal-miners	276	322	1256

that these three particular occupations account for approximately 70 per cent of all deaths due to silicosis. The investigation into the incidence of silicious deposits in the oral tissues was carried out on workers in these three industries.

RESULTS

Before the results of the main phase of the investigation are described, attention must be drawn to a patient who, although he did not follow any of the occupations listed, did have oral lesions which were proved to be due to silica. The investigation of this patient yielded information upon which further work was based. The man attended the Birmingham Dental Hospital complaining of gingival hæmorrhage, inability to wear his lower denture, and a peculiar feeling of "roughness and irritation" of his oral mucosa, particularly on the left side. His symptoms showed remissions and exacerbations, although the feeling of roughness never completely disappeared. On occasion there was also swelling of the regional lymph-glands on the left side. The patient was very worried about this condition and in particular was alarmed at the prospect of malignant disease. On examination the gingiva round his standing teeth was found to be inflamed and slightly hyperplastic. His full upper denture was not a good fit, but he did not complain of any symptoms in the upper jaw. His lower denture was a bad fit, but the oral mucosa was of normal appearance except for the inner aspect of the lower lip which had a slightly granular appearance.

Routine radiographic examination showed some loss of bone around the standing teeth

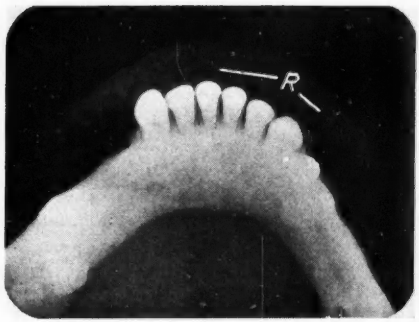


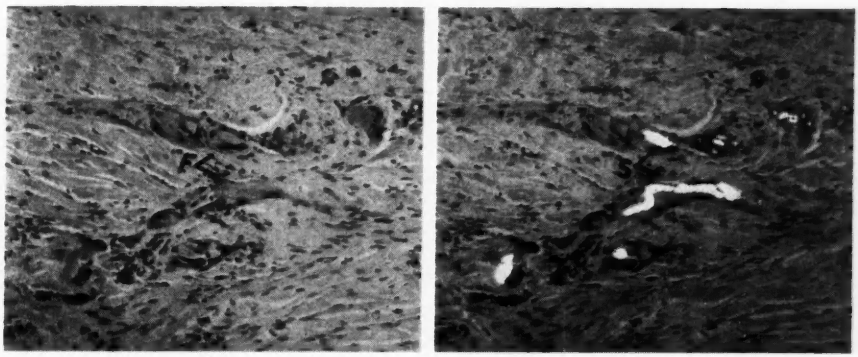
Fig. 1.—Radiograph showing radiopaque areas (R) in the lower lip.

and a most unusual distribution of small radiopaque areas in the lower lip (*Fig.* 1).

These radiopacities were evenly distributed and did not appear to be related in any way to the granular appearance noted on the inner aspect of the lip. In view of the periodontitis which was present, the remaining anterior teeth were extracted and biopsies of both the lip and the gingiva were taken. Microscopical examination of the sections prepared from the lip biopsy was particularly interesting, for it showed the presence of numerous foreign body giant cells containing birefringent crystalline particles. (*Figs.* 2–4.) Other smaller crystals could be seen in association with localized accumulations of macrophages and lymphocytes. Measurement of the refractive index of these birefringent crystals indicated that they were silica. Some of these crystalline deposits were of a large size and there seemed little doubt that a connexion existed between these aggregations and the radiopaque areas seen on the radiographs. No other cause for the radiopaque areas was apparent in the serial sections which were examined. Part of the biopsy specimen was forwarded to Dr. J. G. Helmcke of the Fritz Haber Institute of

Mikromorphologie in West Berlin, who kindly prepared sections and examined them under the electron-microscope. In Dr. Helmcke's opinion the results of his examination confirmed the presence of silicious material. The patient gave no history of any accident which might have accounted for the presence of this material, but he did state that some years previously he had worked in the glass industry carrying out cutting, grinding, and polishing of glass.

It was considered possible that the particles of silica in the tissue of the lip might have come from the abrasive pastes used in the polishing of glass or from the glass itself. Microscopic examination of the abrasives used in the grinding and polishing of glass, however, showed that they were not similar to the foreign material in the patient's lip.



A B

Fig. 2.—A, Foreign body giant cells (F) in the tissue of the lower lip illustrated in *Fig.* 1; B, The same field under partially polarized light showing birefringent crystals of silica (S) in the giant cells. Hæmatoxylin and eosin. (× 100.)

Fig. 3.—Deposits of silica (S) in the tissue from another area of the lower lip illustrated in *Fig.* 1. Partially polarized light. Hæmatoxylin and eosin. (× 56.)

Fig. 4.—Crystals of silica (S) in the cytoplasm of a giant cell. Partially polarized light. Hæmatoxylin and eosin. (× 566.)

The results of the investigations carried out on this patient were significant, for they indicated that deposits of silica in soft tissues such as the lip might be associated with unusual radiographic appearances in those tissues.

Groups of workers in the three occupations mentioned earlier were now examined, and

particular attention was paid to radiographic examination of the lips and gingiva.

Foundry Workers.—Thirty-two workers were radiographed and ten were shown to have small radiopaque areas in the lips similar to those previously seen in association with

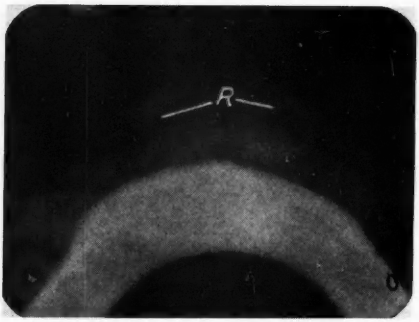


Fig. 5.—Radiopaque areas (R) in the lower lip of a foundry worker known to be suffering from pneumoconiosis.

Fig. 7.—Radiograph of the lower lip of a patient in the control group.

silica. These areas were fairly uniform in size but their distribution varied widely. In some patients they were present throughout the whole of the lip (*Figs.* 5, 6), whilst in others they were more localized. None of the patients complained of any symptoms, and unfortunately it was not possible to persuade any of them to allow a biopsy to be taken.

Pottery Workers.—Radiographs were taken of the lips and gingiva of three pottery workers who were certified to be suffering from silicosis. Two patients had radiopaque areas in the lip.

Coal-miners.—A total of eighteen miners has been examined and of these, eight had radiopaque lesions in the lips.

Control Group.—Radiographic examination of the lips was carried out on 50 patients who had never been exposed to industrial dusts

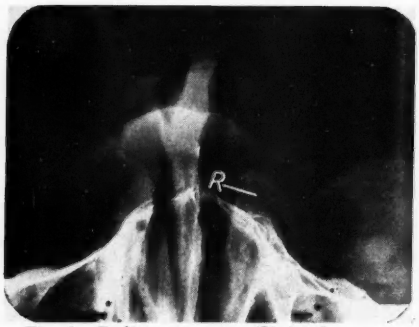


Fig. 6.—Radiopaque areas (R) in the upper lip of a foundry worker.

containing silicious matter. No radiopaque areas were present in either the lips or the gingiva in this group (*Fig.* 7).

Table II summarizes the results of the investigation and shows that radiopaque areas

Table II.—The Incidence of Radiopaque Lesions believed to be associated with Deposits of Silicious Material in the Lips.

Occupation	Total No. Examined	Radiopaque Lesions present in Lips
Foundry workers, including metal grinding	32	10
Pottery workers	3	2
Coal miners	18	8
Total	53	20
Control group—no contact with industrial dust	50	0

similar to those shown to be associated with silicious deposits were present in the lips of 20 workers out of 53 examined. Only one patient out of the 20 complained of any discomfort which might have been attributable to the presence of the lesions in the lip. The incidence of deposits in the gingiva was less striking

and only in one patient were radiopaque areas seen in this location.

DISCUSSION

In surveying the results of this preliminary investigation two points warrant further discussion. The first concerns the peculiar radiopaque areas which occur in the lips of persons exposed to dusts containing silica. Radiologists who were consulted during the course of this work could not recollect ever having seen areas of this type in the lip, although significantly one had seen similar lesions in radiographs of the fingers of foundry workers. Microscopical examination of excised tissue in one case indicated that the radiopaque deposits were directly associated with the silica which was shown to be present.

It is not suggested that the radiopaque zones were due to the silica *per se*. There is evidence (Holt 1957) which indicates that tissues affected by the presence of silica become impregnated with calcium to form a calcium-protein complex which is radiopaque.

It is noteworthy that the majority of the patients who had radiopacities in the lips were certified as suffering from pneumoconiosis. If as a result of further investigations which are now taking place, the relationship between the radiopaque areas, deposits of silicious material in the oral soft tissues, and pneumoconiosis can be clarified, it may be that radiographic examination of the lips of workers in certain occupations can help in the early diagnosis and prevention of the lung disease. If it can be shown that the oral lesions are specific it would be of value to know whether they precede the onset of pneumoconiosis and whether they bear any relationship to susceptibility to the serious lung condition.

The second point which warrants further consideration is the mechanism whereby the silica gets into the oral tissues. The investigation has not yielded any information on this point with respect to pottery workers and miners, but in the case of foundry workers one possible explanation can be advanced. In casting shops compressed air is used extensively to clean the sand off the surfaces of castings and moulds and for this purpose air at a minimal pressure of 80 lb. per sq. in. is used. Frequently the pressure of the air supply is much higher than this minimum figure and it is common practice to use air at a pressure as high as 200 lb. per sq. in. Although it is strictly forbidden to use this compressed air for any purpose other than to clean moulds and castings it is well known in the industry that workers often use this high pressure air to clean their clothing, and even to remove dirt and dust from their faces and hands (Cole, 1959). It is possible that the use of compressed air in this way may provide the force which drives the particles of silica into the tissues.

In conclusion, it should be pointed out that this paper is in the nature of a progress report on an investigation which is still continuing. Much further work will have to be done, and we hope to have the opportunity of carrying out clinical and radiographic examinations of larger samples of workers exposed to industrial dusts.

In addition it is hoped to investigate in more detail the histology of the radiopaque lesions in the lips. Most patients in the absence of any pain or discomfort are unwilling to allow a biopsy to be taken, but the co-operation of general pathologists in the Midlands area has been otained and suitable autopsy material is being made available.

SUMMARY

Radiopaque areas present in the lips of one patient were shown to be associated with a foreign body reaction due to the presence of silica. Radiographic examination of 53 industrial workers exposed to dusts containing silicious matter showed that 20 had similar radiopaque lesions in the lips. These unusual radiographic appearances occurred only in patients in occupations known to cause pneumoconiosis and were not seen in a control group of 50 patients who had not been exposed to dusts containing silicious material.

Acknowledgements.—We wish to record our appreciation of the willing help and co-operation we have received from Dr. C. W. D. Cole

of the West Bromwich Chest Clinic and Dr. P. K. Elliot, Divisional Medical Officer, National Coal Board. We are also grateful for the assistance we have received from Dr. E. H. Springett, Director of the Birmingham Chest Clinic, Dr. A. Wilson Russell, Smethwick Chest Clinic, Dr. E. Posner, Director, Mass Radiography Centre, Stoke-on-Trent, Dr. A. S. Pearson, Chance Bros., Smethwick, Dr. C. Giles, Newcastle City General Hospital, and Dr. F. J. Pick, Stafford Infirmary. Our thanks are also due to Professor J. Gough of the Welsh National School of Medicine for his helpful comment and criticism.

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BOOK REVIEWS

PARTIAL DENTURES. By JOHN OSBORNE, Ph.D., M.D.S., F.D.S., Professor of Dental Prosthetics and Deputy Director of Dental Studies, University of Birmingham; and GEORGE A. LAMMIE, Ph.D., M.D.S., B.Sc., H.D.D., formerly Senior Lecturer in Dental Prosthetics, University of Liverpool, Consultant Dental Surgeon, United Liverpool Hospitals. $8\frac{3}{4} \times 5\frac{1}{2}$ in. Pp. 446+xii, with 246 illustrations. 1959. Oxford: Blackwell Scientific Publications. 45s.

THE first edition of this well-known book was published five years ago. Since this time both of the authors have written papers on the subject and it is not surprising that their current views are now incorporated in the new edition.

In some cases, the second edition of a book bears such a close resemblance to the first that one would think twice about buying it. This is not so in the book under review.

In addition to minor changes, additions and deletions in the text, there has been a very thorough revision of the chapter on model surveying. Also, the authors have discussed the nature and uses of the rubber impression materials. The most noticeable additions, however, are two new and very important chapters on the physiology and pathology of occlusion.

In these chapters the authors follow the current trend away from the teaching of Gysi and others. This "substitutes the neuromuscular mechanism for a purely local concept of muscular action and emphasizes the overriding importance of control by the central nervous system over the stomatographic system". They attempt to provide a neurophysiological explanation for the functional movements of the mandible. Under the heading of "further physiological considerations" the bony changes after extraction are considered, together with the reaction of the bone to pressure. Such changes are also considered in relation to the type of mucosa and the way in which the various types of mucosa affect this process. These chapters are indicative of a new approach to dental prosthetics. The collection of the many new ideas and thoughts into two comparatively short chapters is a most commendable effort.

If the reader only requires a text-book which describes a series of techniques for the construction of dentures he may be tempted to skip these chapters. They are, however, a challenge to see dentistry from a new standpoint—and as such are of great importance not only to the prosthetist but to all who undertake restorative dentistry of any kind.

The more practical approach has not been neglected—the chapters following the sequence of partial denture construction from the preparation of the mouth to the fitting of dentures. The chapters on design are related to consideration of the problems associated with each of the Kennedy classes. Whilst most of the designs illustrated are acceptable, some will be criticized for their complexity. It is

unusual, for example, that a stress-broken design should be necessary for a Kennedy Class III denture.

It does not always follow that a design which fulfils a theoretical ideal is necessarily the only denture that can be fitted, and it is to the authors' credit that the alternative designs are given equal prominence.

The book is well illustrated, there being 64 new illustrations in the second edition.

Each suggested design is not only photographed but also illustrated by a line drawing. The design is thereby easier to understand and this feature will certainly be appreciated by students.

There are few books on partial dentures which really face all the problems involved. It is a difficult subject to teach and even more difficult to practise.

This book will help both students and practitioners to understand the difficulties and in so doing to overcome them.

A. O. M.

TUMOURS OF THE ORAL REGION. Edited by HAMILTON B. G. ROBINSON, D.D.S., M.S., Dean, University of Kansas City School of Dentistry, Kansas City—Western Dental College. With contributions by various authors. $8\frac{7}{8} \times 5\frac{3}{4}$ in. Pp. 143 + vi. Illustrated. 1958. Philadelphia and London: W. B. Saunders Co. Ltd. 21s.

THIS book is a special reprint of one half of the November, 1957, issue of *Dental Clinics of North America*.

In addition to an introductory chapter touching on aetiology, precancerous lesions, and the dental surgeon's part in diagnosis by the editor, there are chapters by twelve other distinguished contributors. These cover the oral cavity, region by region, and are rounded off by chapters on treatment and oral and facial prostheses.

As is to be expected, the contributors vary in what they discuss under the heading of tumours. Some appear to confine themselves strictly to neoplasms, benign and malignant, while others discuss inflammatory swellings and congenital malformations as well. In part, the particular approach adopted appears to depend on the types of lesion most commonly found in the region under discussion.

On the whole, this book amply fulfils its aim of providing a brief, authoritative review for the general practitioner. The reviewer is doubtful, however, whether the choice of anatomical regions as a means of dividing the subject among the various contributors was an altogether happy one. In a few cases the choice is a natural one, for example "tumours of the salivary glands"—an excellent account of a difficult subject—but with other regions a considerable amount of repetition is inevitable. This jars a little if the book is read straight through, but of course is not noticeable if each contributor's paper is read separately.

G. R. S.

HANDBOOK OF ORTHODONTICS FOR THE STUDENT AND GENERAL PRACTITIONER. By ROBERT E. MOYERS, D.D.S., Ph.D., Professor of Orthodontics, School of Dentistry, University of Michigan. $7\frac{3}{4} \times 5\frac{1}{4}$ in. Pp. 498 + xv, with 272 diagrams. 1959. Chicago, Illinois: Year Book Publishers Inc. ($11.00). (London: Interscience Publishers Ltd.) 83s.

THIS is one of the few books which an undergraduate or general practitioner can read without coming to the conclusion that the mysteries of orthodontics are known only to a select band of initiates. No teacher is ever likely to agree with all the statements in another's text-book. Moyers describes the observations which led him to any opinions likely to be in dispute, so that a teacher who disagrees can explain how different conclusions might be reached.

The book opens with the usual chapters on growth and development. The section on embryology is commendably brief. There is no nonsense about air pressures in the nasal fossæ, and the growth of the facial bones in the young patient is more clearly described than in most books. Aetiological factors are described in a matter-of-fact manner, but it would be an advantage to state more forcibly the influence of the oral musculature and to give the student more guidance in the recognition of the different types of lip posture and

tongue and lip behaviour. In a later chapter the difficulty in treatment of maxillary prognathisms and protrusions is attributed to the unfavourable skeletal relationship without sufficient reference to the soft tissue factors.

In discussing systems of classification, Angle's relationships are described as relating to the mandible and the maxilla. In this country I think most orthodontists apply Angle's classification to the dental arches in occlusion and make a separate skeletal classification, after Ballard.

The boldest venture is the inclusion of a section, more than half the book, on the treatment of clinical problems. This is written with the general practitioner or part-time orthodontist in mind and is well done. It is refreshing to read that orthodontists need not impose upon their patients any preconceived ideas of how the patient's profile should look, and that patterns of growth are determined more by genetic factors than by the clinician's wishes.

With the possible exception of lower stabilizing plates, the use of cemented bands in retaining removable appliances is cumbersome, but the author is evidently not personally acquainted with Adams's cribs and his faith in the ability of the palatal mucosa to provide anchorage for retracting incisors may be short-lived. The technique of constructing "the hollow bite plane" is helpful and will reduce the time spent in trimming.

The book is a convenient size, a true manual, and the production and illustrations are first-class. J. S. B.

TEXTBOOK OF BIOCHEMISTRY FOR STUDENTS OF DENTISTRY. Edited by Joseph C. Muhler, D.D.S., Ph.D., F.A.C.D., Professor of Basic Sciences, Indiana University School of Dentistry, Indiana. $9\frac{1}{2} \times 6\frac{1}{2}$ in. Pp. 539, with 88 tables and many line drawings. 1959. St. Louis: The C. V. Mosby Co. (London: Henry Kimpton). 67s. 6d.

This is an elementary text-book of the fundamentals of biochemistry. It differs from the normal text-book in that most of its nine co-authors are biochemists or chemists with a direct interest in dental science. The book provides for the requirements of the undergraduate dental student reading for his examination in biochemistry, and in addition has the merit of emphasizing some specialized aspects of the subject which are of particular interest to the dentist.

Each of the nine contributors is an active worker in the subject of which he writes. The multiplicity of authorship results in styles of composition of varying quality, but the book is readable and reflects credit on the editor.

One or two errors in type and chemical formulæ were noted, e.g., chondroitin sulphate is shown with a direct carbon-sulphur linkage instead of an ester linkage.

Considerable space is given to the chapters dealing with the constituents of an adequate diet. This is to be applauded since it provides a sound basis for the dental student's future studies. The chapters on saliva, fluoride metabolism, and drugs and chemotherapy are innovations not normally found in similar text-books. The chemistry of carbohydrates, proteins, and fats is well done, and the metabolic chapters are clearly written.

This is a book which should be of use not only to the dental student but to the practitioner who wishes to keep in touch with biochemical thought which underlies so much research in the field of dental science.

R. L. H.

INTRODUCTION TO DENTAL ANATOMY. By James Henderson Scott, D.Sc., M.D., L.D.S., Reader in Anatomy for Dental Students, The Queen's University, Belfast; and Norman Barrington Bray Symons, M.Sc., B.D.S., Senior Lecturer in Dental Anatomy and Histology, and Curator of the Dental Museum in the University of St. Andrews at the Dental School, Dundee. Second edition. $8\frac{1}{2} \times 5\frac{1}{2}$ in. Pp. 344 + xii, with 219 illustrations. 1958. Edinburgh and London: E. & S. Livingstone Ltd. 42s.

The second edition of this book has now been available for over a year and has gained even more popularity than the first edition. That the book is a great improvement on the first

edition is evident; a large number of the faults contained in the first edition have been removed, a lot of new material has been added, and the presentation rearranged.

There are, however, a few features of this book which are open to criticism. The presentation of factual data is for the most part clearly expressed although few controversial topics are fully dealt with. In consequence the text tends to be rather too didactic for the discriminating student. It is arguable whether this form of presentation is really the best one for an introductory work since it leaves an impression of finality in the mind of the students on some topics, and an unfortunate uncertainty about others. For example on page 153, the suggestions that enamel spindles do not actually enter the enamel, but are an exaggerated form of the projection which alternate with the bays of the enamel–dentine junction is mentioned, without any attempt on the part of the authors to express their own opinions about this rather curious idea. Neither do they give any further information which would help the enthusiastic student to form his own opinion. A list of references is included at the end of each chapter, and although these are excellently selected reading for students, the student must unfortunately read all of them before he is able to trace the source of any statement in the text.

Furthermore, because the references have been selected without reference to the text, many controversial topics are raised without indicating their source; this results in quite the wrong emphasis being placed on some statements. For example, although it is generally believed that nerves do not terminate within the cytoplasm of other cells, in the 148 words devoted to the innervation of dentine, space is devoted to the possibility that "nerve may even terminate inside the odontoblast", without giving the reader any guide as to how acceptable this idea is in relation to biological concepts of the present. The brevity of this type of presentation seriously limits the histological section of the book, which is otherwise so well prepared that it is rapidly becoming the principal text-book of British students, and this is unfortunate, because the authors never intended the book ever to become any more than an introduction to dental anatomy, a purpose which it serves far better than any other current publication. R. W.

DENTAL COURSES

The publishers of *The Dental Technician* will shortly commence lectures and practical courses on the following techniques: porcelain jacket crowns; all aspects of full and partial denture work, i.e., model surveying, construction of precious metal and chrome-cobalt alloy dentures; the construction of both fixed and removable orthodontic appliances.

Each class will be limited to ten students, and will be held at Claudius Ash, Sons & Co. Ltd., 26 Broadwick Street, London, W.1. Those persons wishing to take advantage of either one, two, or three courses should write to: The Secretary, *The Dental Technician* Training Courses, 331 Gray's Inn Road, London, W.C.1, stating the course or courses chosen, and enclosing a stamped and addressed envelope.

Charges for these courses will be kept as low as possible.

LETTER TO THE EDITOR

October 26, 1959

Dear Sir,

Your editorial, followed by J. R. Grundy's article on the polishing of amalgam fillings, raises some interesting questions.

1. Is there any clinical evidence that highly-polished amalgams have any advantage over normally compressed and contoured unpolished amalgam fillings?

2. Is there any clinical evidence that teeth with highly-polished amalgam fillings last longer than those with unpolished fillings? The enamel–amalgam junction is not directly under discussion but is, of course, of considerable importance.

3. Is it not probable that the heat generated by the polishing process, as carried out in a busy practice, is detrimental to the final filling?

All practitioners like to see nicely polished fillings, and it is probable that an operator who takes care to polish his fillings takes equal care to prepare the cavity and pack the amalgam. If, however, the high polish is unnecessary, then the time spent would appear to be wasted.

Yours faithfully,

D. F. Glass

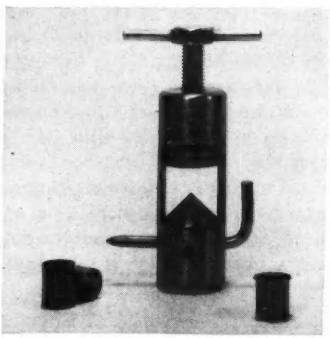
4, *Elwick Road*,
Ashford,
Kent.

NEW MATERIALS AND APPLIANCES

THE new materials and appliances briefly reported here have recently become available to the profession. For further information the reader should write direct to the manufacturer.

Nyman Copper Ring Flanging Device

FORMS a flange on copper rings for crown and inlay impressions, thereby allowing easy and speedy removal from the tooth, without lacerating the operator's finger-tips. The



latter is a frequent occurrence when rings are prepared by usual methods. The device will also form internal flanges on rings being used as temporary crowns. Thus the patient's comfort is increased. The prepared tooth is protected with a ring which presents no sharp edges to the soft tissues. Price 25s. (Cottrell & Co. Ltd., 15/17 Charlotte Street, London, W.1.)

Faster X-ray Films

FASTER dental X-ray films are offered by Kodak. The speed of both periapical and bite-wing films has been doubled. This minimizes the possibility of radiation hazard without sacrificing the qualities of fine-grain optimum contrast and exposure latitude. The films are double packed and available in the usual sizes. (Kodak Ltd., Medical Sales Division, Kodak House, Kingsway, W.C.2.)

Revised Casting Technique for Pallacast

THE soft reducing flame previously recommended for melting Pallacast was in connexion with the use of open crucibles of the type employed for pressure casting. With centrifugal casting machines where the metal is melted in a heavily cowled crucible, a smaller harsher flame is required to penetrate its depth. A large flame produces an excessively reducing atmosphere and the consequent incidence of gas porosity in the casting. With a centrifugal machine, sounder, denser castings are produced if the metal is melted with a slighter reducing flame. A new flux under the name of "Sterling Casting Flux" has been developed and is available from the dental supply houses

Aspirating Syringe

AN aspirating syringe designed for use with Xyal cartridges has been introduced, named the Xyringe. A harpoon hook on the syringe piston enables the plunger to be withdrawn to produce aspiration before the injection is made. Price: £2 17s. 6d. (Astrapharm Ltd., Kingston-upon-Thames, Surrey.)

Hostacain "Special"

FIFTY years of research are behind the development of Hostacain "Special". A construction of hostacain phosphate 2 per cent and procaine phosphate 1 per cent, the following advantages are claimed: Rapid onset of anæsthesia (up to two minutes); Profound anæsthetic effect; Short duration, average one hour. Price: 21s. per jar of 50 graduated cartridges. (Hoechst Pharmaceuticals Ltd. Distributed in the U.K. by Horlicks Ltd., Slough, Bucks.)

New Drugs

A RANGE of drugs for the treatment of caries, pulp infections, hæmorrhage, and paradontal infections under a variety of trade names is now available by Steptodont of Paris. (U.K. Agents: James Rouse Ltd., Sheffield 1.)

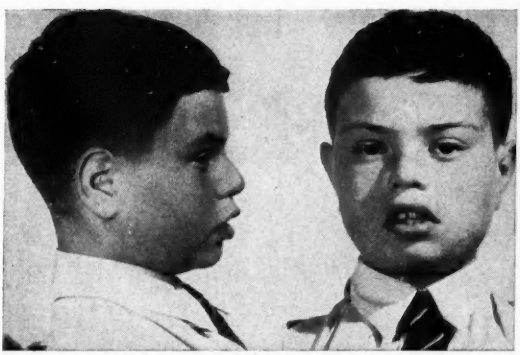
TREATMENT OF A CASE OF ANGLE CLASS II, DIVISION 1 MALOCCLUSION, COMPLICATED BY GROSS OVERCROWDING*

By **R. T. BROADWAY**, M.D.S. (Lond.), F.D.S., D.Orth. R.C.S.
Orthodontic Department, Eastman Dental Hospital

CASE REPORT

THIS patient, aged 10 years (*Fig.* 1 A), was referred by his general dental practitioner to the Eastman Dental Hospital for orthodontic treatment.

His orthodontic diagnosis was as follows: "He has a Class II dental base relationship with an Angle Class II, division 1 type of malocclusion, complicated by gross overcrowding in both upper and lower arches (*Fig.* 1 B). All four buccal segments are forward in relation to the labial segments. The lower central incisors are very proclined, and the lower lateral incisors are lingual to them. The upper central incisors are also proclined, and the upper lateral incisors have erupted palatal to them: the left upper lateral incisor is also in lingual relation to the left lower central incisor. The upper first permanent molars are rotated forward and the upper second premolars have erupted palatally. The upper left deciduous canine and the lower second deciduous molars are still retained, and the upper permanent canines and the lower second premolars are unerupted. It was also noted that the clinical crowns of the lower central incisors were long and that the gingival recession was most marked on the left lower central incisor, which was in traumatic occlusion with the left upper lateral incisor.



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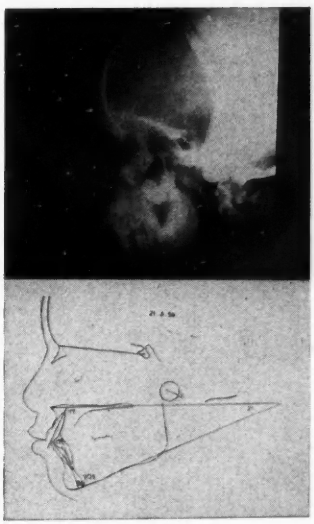

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Fig. 1.—A, Photographs of patient prior to treatment; B, Models at start of treatment; C, Lateral skull X-ray and tracing at start of treatment.

Given at the Manchester meeting held on April 17, 1959.

A

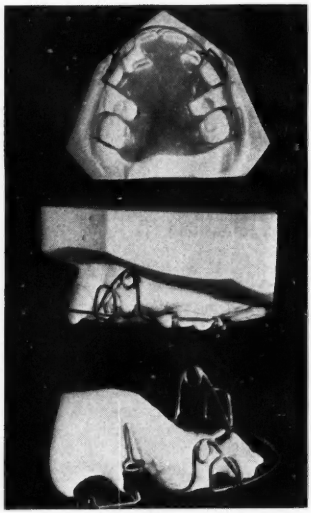

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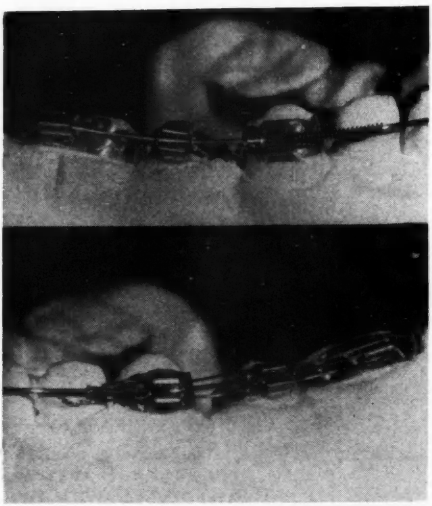
Fig. 2.—A, Simple 0·7 mm. lower lingual arch space maintainer; B, Removable upper space maintainer incorporating springs to retract $\underline{3|3}$ and move $\underline{5|5}$ buccally.



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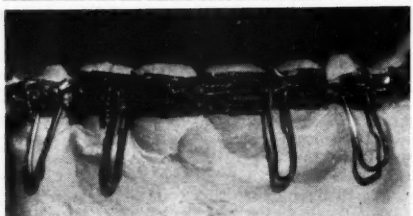

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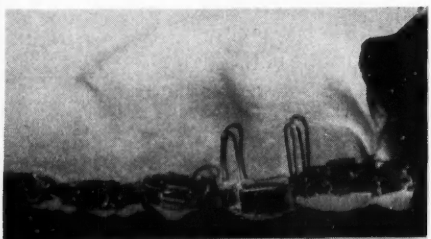

D

E

Fig. 3.—A, Lower multiband appliance to retract $\overline{3|}$ showing coil spring in passive position; B, Showing coil spring to $\overline{|3}$ activated by ligating back to distal of $\overline{|6}$; C, Lower multiband appliance showing archwire with third power bends to aline $\overline{21|12}$; D, E, Upper multiband appliance to aline $\overline{21|12}$—D in passive position and E activated by tying into brackets.

The upper centre line was over the right by 2 mm. His lips are incompetent; and he has a full everted type of lower lip" (*Fig.* 1 A).

The lateral skull X-ray (*Fig.* 1 C) shows a bimaxillary proclination of incisors. It was felt that the axial inclination of the lower central incisors to the mandibular plane was not their true position of balance within the musculature, but was an artificial position due to the gross crowding in the lower incisor region forcing the lower central incisors out labially. It was felt that the stable position for the lower incisors was more likely to be that of the lower lateral incisors and that treatment should aim at that result. It can also be seen from the lateral skull X-ray that the upper apical base is short, as is indicated by the distal axial inclination of the upper second permanent molars, and that the upper third molars are developing vertically above the upper second molars. The unerupted upper canines are seen to be well forward in relation to the central incisors.

The treatment plan involved the extraction of all four first premolars, retraction of canines, retraction and alinement of the incisors.

TREATMENT.—In the lower arch, immediately following the extraction of the lower first premolars, a 0·7 mm. lower lingual arch, with bands on lower first permanent molars, was fitted (*Fig.* 2 A). This was a space maintainer to prevent the lower first molars from coming forward, and at the same time to allow the lower canines and incisors to move distally and start to aline under lip pressure: whilst waiting for the shedding of the lower second deciduous molars and eruption of the lower second premolars.

In the upper arch, following extraction of the upper first premolars, an upper removable appliance was fitted (*Fig.* 2 B). This was again a space maintainer, for use whilst awaiting the eruption of the upper canines. It incorporated buccal canine retractors to enable the appliance to be used to retract the canines when they erupted: the free ends of these retractors were tack welded to the labial bow so that they would not irritate the soft tissues. When the canines erupted they could be unwelded and used. The labial bow is of the reverse type, so that extra oral traction could be used, if necessary, to prevent the buccal segment coming forward during the retraction of the canines. On the palatal side of this appliance are springs to push the palatally placed second premolars bucally.

When the lower second premolars had erupted sufficiently, bands were cemented on these teeth and the lower canines and a 0·018 in. labial arch wire was ligated (*Fig.* 3 A, B). This had coil springs mesial to the canines tied back to the distal of the first molars; the arch wire was turned down distally. Thus first molars and second premolars were used as anchorage to retract the canines. When the lower canines were retracted distally, bands were placed on the lower incisors,

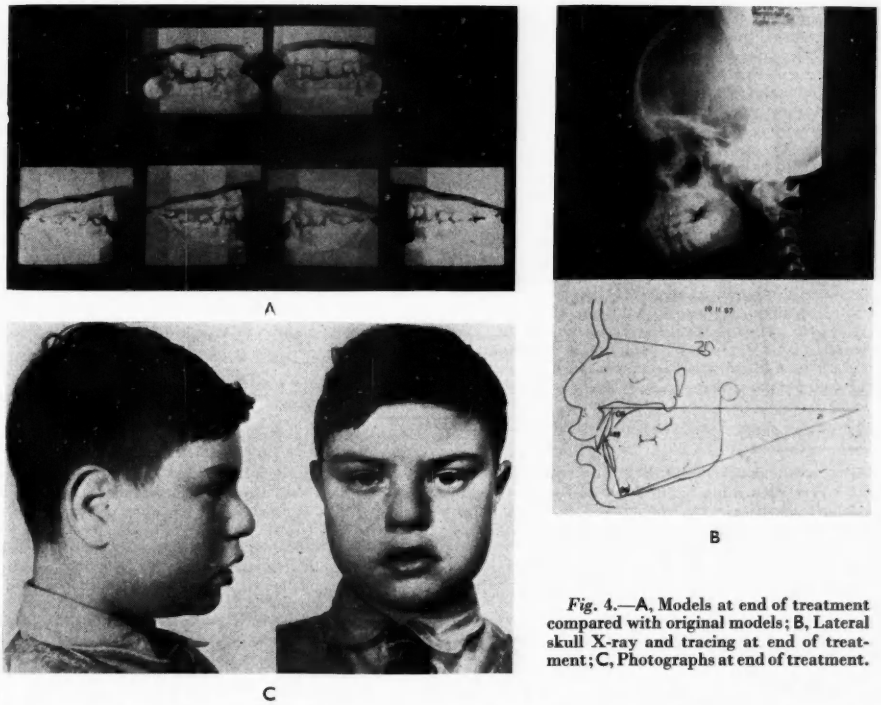

Fig. 4.—A, Models at end of treatment compared with original models; B, Lateral skull X-ray and tracing at end of treatment; C, Photographs at end of treatment.

and a 0·016 in. arch with third power bends (*Fig.* 3 C) was ligated to start their alinement.

In the meantime, in the upper arch the canines had erupted and were retracted and the second premolars had been moved out buccally. It was noted that the canines were somewhat rotated on eruption. During visits for adjustments to the appliances, bands had been made for the upper arch; they were now cemented and a 0·014 in. arch with third power bends, supported by Class II traction (*Fig.* 3 D, E) was ligated. This arch was not fully tied into the upper lateral incisors initially: the ligatures were gradually tightened over a period of four months. This arch moved the laterals labially and by reaction the central incisors were moved palatally. Class II traction supported the buccal segments and prevented their forward shift, and at the same time helped in the closing of the lower first premolar spaces.

When the upper and lower incisors were alined it was possible to insert 0·018 in. plain arches. To these arches Class II traction was applied in order to reduce the overjet and close the lower first premolar spaces; in the lower arch intra-traction was also used by means of rubber bands, to prevent proclination of the lower incisors due to frictional resistance of the arch in the channels of the brackets. Finally, 0·022 in. plain arches were inserted. Upper and lower bands were removed sixteen months after the start of treatment. Retainers were fitted and used for final closing of band spaces; the upper retainer was cut away behind the upper incisors and the labial bow activated. Retainers were worn for seven months. He was seen again at intervals after the retainer had been left out. *Fig.* 4 shows the models taken six months out of retention compared with the original models and post-treatment photographs and X-rays.

COMMENT

This case is of interest in that it illustrates the use of various types of appliances to achieve the necessary movements. Summarizing the treatment: removable and simple fixed appliances were fitted initially to undertake the first tooth movements, and whilst these were taking place bands were being made which were cemented when the time came to start the more complex tooth movements; thus, little or no time was wasted. Finally, bands were removed and retainers fitted, with which the final positioning of the teeth was accomplished. The total treatment time including retention was two years and one month.

Acknowledgements.—I would like to thank Mr. S. G. McCallin for permission to present this case; Mr. C. V. Hill for his advice and help in the practical treatment of the case; and finally Mr. E. Morgan, and his staff of the Photographic Department of the Eastman Dental Hospital, for the production of the slides.

DISCUSSION

The President thanked Mr. Broadway and added that it was a very good thing for them to deal with straightforward orthodontics at the beginning of their Conference in this way. They appreciated the way in which the cases had been presented.

Mr. W. J. Tulley congratulated Mr. Broadway on the presentation of the case. However, little had been said about soft tissue activity. If the position of the lower lateral incisors was stable, why had Mr. Broadway pulled them forward and why had he used Class II elastic traction? Why had he not used extra-oral traction?

Mr. Broadway said he was surprised, himself, that there were remaining lower first premolar spaces in this case. For the whole time he was using Class II traction he was also using intramaxillary traction in the lower arch, and that this was a little more powerful than the Class II traction. It was probably misleading to say that he was pulling forward the lower lateral incisors while retracting the lower centrals. It was a matter of retraction of the lower centrals and using the rest of the lower arch as an anchorage for doing that.

Mr. Tulley asked why the two centrals were forward.

Mr. Broadway said that perhaps the gross crowding in both arches might have the effect that the upper lateral incisors would erupt lingually to the lower central incisors which with the crowding already present in the lower arch resulted in the lower central incisors being further proclined.

Mr. P. H. Burke thanked Mr. Broadway and said he would like to refer to the remarks made about gingival recession of the mandibular incisors. He would like to know whether that aspect had been followed up and the effect when the central incisors were re-alined. In his experience of similar gingival recession associated with linguoocclusion of a maxillary incisor and labial displacement of a mandibular incisor, the position remained static after alinement, and gradually, with the passive eruption of the other teeth, the gingival attachments became level.

Mr. Broadway said that in this particular case the gingival recession had not progressed. He was interested to hear about what happened with the eruption of other teeth. He had not noticed that, but certainly the position in his own particular case was no worse than when he had seen it originally.

Mr. D. F. Glass asked whether Mr. Broadway could give a rough indication of how many chairside hours he had devoted to the work.

Mr. Broadway said he could not give an estimate in chairside hours. Initially the patient had very simple appliances. He attended for treatment about every month or six weeks, and at each visit a few bands were made for him. The visits never lasted for longer than three-quarters of an hour, and if two bands were made at a visit, this was regarded as satisfactory. The total number of visits was not large and the total time spent on the case was not great.

Mr. Ritchie's question was that he noticed that lips were apart at the beginning and end of treatment and had Mr. Broadway tried the use of Elastoplast across the lips at night.

Mr. Broadway said he believed that the incompetent lips were an inherited characteristic which was unchangeable. The lips were incompetent; they were not potentially competent. Even at the end of treatment one would expect very little or no change in the lip incompetence. He did not believe the use of Elastoplast was justified. The mother had the same sort of lips and the child had inherited a family characteristic.

The President said he was sure it would be agreed that the case was still unfinished. It would be most interesting in, say, five years' time to see how it had progressed after further natural tooth movement had taken place. It would be well worth watching over the passage of years to observe the tendencies that occurred.

Mr. Poulter thanked Mr. Broadway. The case had been referred to, he believed, as a Skeletal II. Could the author enlarge upon the diagnosis? Regarding the musculature of the mother, had she had any orthodontic treatment or were her teeth in the same position? He agreed it would be interesting to see the case five years hence, after the orthodontic treatment had had sufficient time in which possibly to influence the musculature.

Mr. Broadway said he could give no information as to the mother's teeth: she was wearing full upper and lower dentures. When she had brought her child for treatment she had simply said that he had two rows of teeth, and examination of the mouth confirmed that this suggestion was quite reasonable. The inclination of the upper incisors to the maxillary plane was proclined from the mean. If the upper incisors were corrected to the mean and the lower incisors were similarly corrected, the lower incisors would be biting behind the uppers. That was called a Class II dental base relationship.

Mr. J. S. Beresford thanked Mr. Broadway for the paper. It was quite an event when someone came and read a paper to the B.S.S.O. Although so far as dental societies went they were as amiable as any, such a gesture called for courage and they were grateful to anybody who rendered such a service. He hoped the author would forgive him for asking two questions which sounded as if they came from the L.D.S. Finals. It might help if at the beginning of the Conference a number of definitions were made clear. How did the modern orthodontist define "nasal plane", and what points should one use on the X-ray plate? Also, what points should one use for the mandibular plane?

Mr. Broadway showed a slide and indicated the points thereon.

The President: Do you use the right or left or strike a medium?

Mr. Broadway: We strike a medium.

Mr. J. W. Softley asked what importance the author attached to cuspal interdigitation. The final slide relating to the paper showed that the occlusion of molars and the remaining premolars was still incorrect. Had an evaluation of the inclined plane action been made?

Mr. Broadway said he had not made an evaluation. He knew that on one side the occlusion was Class I and on the other side there was a slight Class II relationship. During the past eighteen months the occlusion had not changed at all.

The President said he felt that the discussion could go on for a long time. It was useful to have such cases discussed. He hoped there would be even more opportunities for them in the future to learn how various cases were treated. It was possible that some of them would treat a specific case in different ways, but it was instructive, for those with much experience as well as those with less, to be told how others set to work.

The Mucus Retention Phenomenon

Routine histological preparations of surgical specimens from 97 cases of the mucus retention phenomenon were studied together with clinical data about the patient. Forty-eight cases were males and 47 females; in 2 cases the sex was not given. There was no special age incidence and only 2 cases occurred in negroes. Forty-three lesions occurred on the lower lip, 15 on the buccal mucosa, 15 on the floor of the mouth and ventral surface of the tongue, 7 on the palate, 5 in the retromolar region, and in 12 cases the location was not given. No cases were recorded on the upper lip; 23 patients gave histories of recurrent lesions, 15 spontaneously opened and drained, and 2 patients opened the lesions with a needle. In 9 cases the lesion followed trauma, and commonly biting the lower lip.

No epithelial lining was found in the histological section of 93 of the lesions studied. In these cases the wall was either condensed connective tissue or ragged granulation tissue. In some instances this appeared to be growing into the mucus pool. Six lesions had a partial or complete epithelial lining, in 4 cases the lining cells resembled oncocytes. Many of the pools of mucus were related to gland ducts. In some cases these ducts were dilated with mucus, in others a rupture communicating with the pool could be demonstrated. Forty-six of the affected glands were pure mucus glands and 20 mixed. In only 11 of these glands was there evidence of duct blockage and then only affecting tiny lobules.

It was concluded that these lesions result from an escape of mucus from a ruptured duct into the adjacent connective tissue, and that this escape prevents the appearance of phenomena associated with acute duct ligation.—STANDISH, SAMUEL M., and SHAFER, WILLIAM G. (1959), *J. oral Surg.*, **17**, 15.

USES AND MODIFICATIONS OF THE JOHNSON TWIN WIRE ARCH

By **J. R. E. MILLS**, M.Sc., F.D.S., D.Orth. R.C.S.
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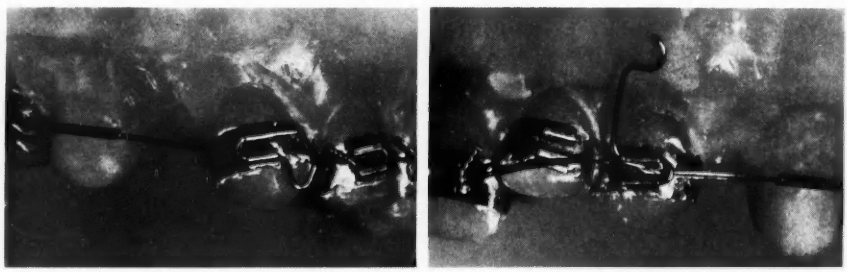
THE Johnson twin wire arch was first described by its originator in 1934 and subsequently in a number of papers including those in 1938 and 1942. Its description has been amplified by Madden (1948) and it was first introduced into Great Britain in a modified form by Townend (1947).

The appliance is, therefore, well known, and it is not proposed in this paper to describe the principles involved. I have been using the appliance for eleven years and I am proposing rather to describe those uses of the appliance which have stood the test of time.



A B

Fig. 1.—A, Individual traction hook on upper canine. B, Modified traction hook, for use where it is desired to reduce tilting of canine.

In making the twin arch, the first step is to construct molar bands on suitable posterior teeth and bands for the four incisors and, in some cases, the canines. An impression is taken with molar bands in place but without the incisor bands, and a model is cast. A piece of stainless steel tubing of internal diameter 0·9 mm. is soldered to the buccal face of the molar band in such a position that an extension of this tubing would lie level with the middle thirds of the incisor teeth. The easiest way to achieve this is to solder on a long piece of tubing to each band so that they meet in front of the central incisors in the manner described by Adams (1957). If the tubing is nicked with a file before soldering, the surplus may easily be broken off when the operation is complete. The twin wire arch consists of a central section of two wires 0·25 mm. in diameter, and two end sections made of tubing of 0·5 mm. internal and 0·9 mm. external diameter. These "end tubes" should be as long as possible; they should project slightly from the distal end of the buccal tubes on the molar bands and, at their anterior ends, they should finish about 4 mm. behind the most distal bracket on the anterior teeth. Having cut the tubes to the required lengths, a piece of 0·25-mm. wire is bent double and the end tubes are placed on the wire. They are adjusted against the model to the position which they will finally occupy, and the protruding ends of the twin wires are bent at an angle where they leave the end tubing. The tubes are then moved to the centre of the wire and that part in front of the sharp bends is kinked or "crimped" five or six times. The

Given at the Manchester meeting held on April 17, 1959.

end tubes are slid distally on to this crimped part of the wire until they come into contact with the sharp bends, by which time they should be in the correct position. The protruding ends of wire are cut off and any sharp ends are stoned. The twin arch is then fitted to the plaster model; it may be necessary to bend the anterior part of the end tubes lingually to follow the line of the arch, but the twin part should lie along the middle third of the incisors without bending the end tubes gingivally or occlusally. It is important that about 7 or 8 mm. of the end tube in front of the buccal tube should be quite straight, so that it may slide into the buccal tube.

The anterior part of the arch is ligated to the bands by means of "ripple brackets" as shown on the lateral incisor in *Fig.* 1 A. These are pressed from stainless steel tape 2·5 mm. wide by 0·2 mm. thick. They are welded to the band and their position should be such that when the teeth are finally alined the brackets will be level with each other. When welded to the band, the bracket forms two small tubes, one along its incisal edge and one on its gingival edge. The twin wire is attached to the band by means of a soft ligature wire of 0·3 mm. diameter. This is made into the shape of a hairpin with one arm longer than the other. The two arms are threaded one at a time through the small tubes of the ripple bracket and the free ends pulled tight and twisted tightly together. The twin wire is thus tied into the central gutter of the bracket but is free to move mesially and distally. The sharp end of the ligature wire is tucked away between the two teeth.

The above description applies in a typical case and there may be some variation to meet special requirements.

RETRACTION OF CANINES

In many cases, first premolars are extracted and the first step is to retract the upper canines. I normally prefer to do this by means of a removable appliance, which has better anchorage and reduces the likelihood of forward movement of the buccal segments. Occasionally, I use the twin wire for this purpose and, in this case, use the individual traction hook shown in *Fig.* 1 A. It is constructed of 0·5-mm. hard wire. A suitable piece is bent into a U shape so that the two arms will pass through the two tubes of the ripple bracket on a canine tooth. The twin arch is trapped between the U portion and the band itself, but it is important that it should be free to move mesially and distally and it

Fig. 2.—Occlusal view of upper arch, after retraction of $\frac{3|3}{}$, showing appliance for lingual movement of upper incisors.

may be necessary to bend the U portion slightly to permit this. The incisal end of the U is bent downwards and fashioned into a hook while the gingival end is cut off short. From this hook an intermaxillary elastic runs to the lower arch, either to a retraction plate or to a lower fixed appliance.

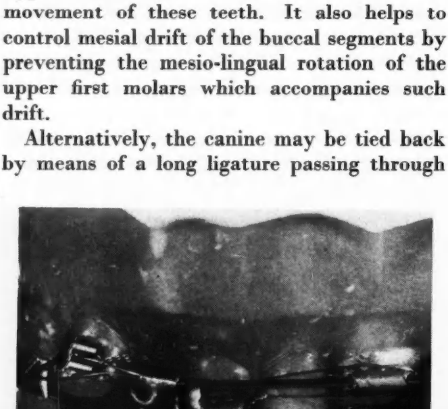
An alternative type of traction hook is shown in *Fig.* 1 B. In this case, the more gingival arm of the U is bent upwards to form a hook which lies over the root of the tooth. Elastic traction from this hook will tend to move the root as well as the crown of the tooth and thus reduce tilting. The former type of hook can be used where the canine is mesially inclined and the latter type if it is vertical or distally inclined.

Having retracted the canines, they should be held back to prevent relapse while the incisor teeth are alined. This is best done by means of a Mershon lingual arch as shown in *Fig.* 5. This is attached to the molar bands and carries spurs which run mesial to the

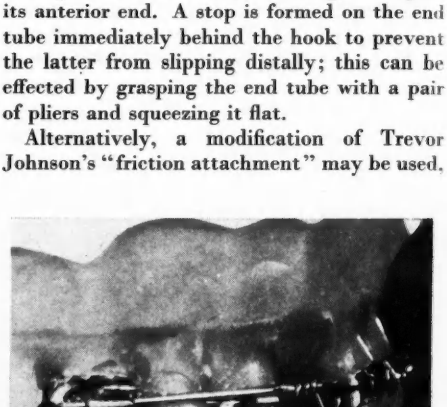
canines. It does not fit closely behind the upper incisors since this would interfere with movement of these teeth. It also helps to control mesial drift of the buccal segments by preventing the mesio-lingual rotation of the upper first molars which accompanies such drift.

Alternatively, the canine may be tied back by means of a long ligature passing through its ripple bracket and around the distal end of the buccal tube as shown in *Fig.* 3 A.

The incisors may now be alined. This will involve one or more of several tooth movements which will be described separately but which may, in fact, be combined.



A



B

Fig. 3.—A, Hook, soldered to tubing, for intermaxillary traction. B, "Friction lock" hook for intermaxillary traction.

THE LINGUAL MOVEMENT OF UPPER INCISORS

The end tubes of the twin arch slide freely inside the buccal tubes while the anterior part is ligated to the incisor teeth as shown in *Fig.* 2. If a force is applied to the end tubes so as to move them distally into the buccal tubes, it will have the effect of moving the crowns of the upper incisors lingually. The most satisfactory way to do this is by means of an intermaxillary elastic to a hook at the anterior end of the end tube. A rigid hook fastened directly to the end tube is not recommended since it is difficult to position this and it has a tendency to project buccally or lingually. The hook may be constructed from a piece of 0·5-mm. brass wire which is soldered to a short length of tubing of 1·0 mm. internal diameter, as shown in *Fig.* 3 A. This tubing is then passed on to the end tubing and up to its anterior end. A stop is formed on the end tube immediately behind the hook to prevent the latter from slipping distally; this can be effected by grasping the end tube with a pair of pliers and squeezing it flat.

Alternatively, a modification of Trevor Johnson's "friction attachment" may be used,

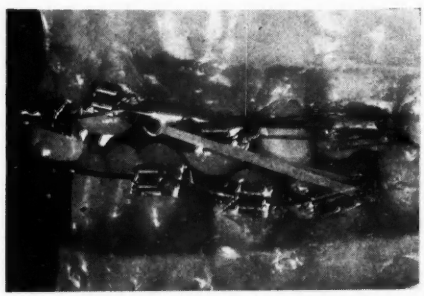


Fig. 4.—Intermaxillary traction for lingual movement of upper incisors and simultaneous mesial movement of lower buccal segment.

as shown in *Fig.* 3 B. A piece of 0·6-mm. wire is wound round a core of 0·8-mm. wire to form a very short coil of three or four complete turns. This may then be forced on to the end tube by rotating it gently as it is pushed forward to the anterior end. When it is in place, the free end of the wire is fashioned into a hook as shown. This device should grip the end tube tightly but, in practice, it is advisable to place a stop on the end tube just behind it.

Having fixed the hooks on to the twin arch, it is inserted in the mouth. The patient wears intermaxillary elastics as shown in *Fig.* 4, and it is sufficient if these are worn at night only. The other end of the elastic band may go either to the type of fixed appliance shown in *Fig.* 4, to a lower traction plate, or to a lower lingual arch. The reciprocal effect would be to move the lower arch forward; as four upper incisors are being moved against the whole lower arch this is not usually serious.

One sometimes encounters a case where a canine is retracted to its desired position but there is residual spacing behind it. In this case it is desired to move the upper incisors lingually and the posterior teeth mesially. Intra-maxillary traction is employed and the appliance previously described may be used with the elastic band running behind the protruding end of the end tubing instead of to the lower arch. Alternatively, the technique shown in *Fig.* 5 may be used.

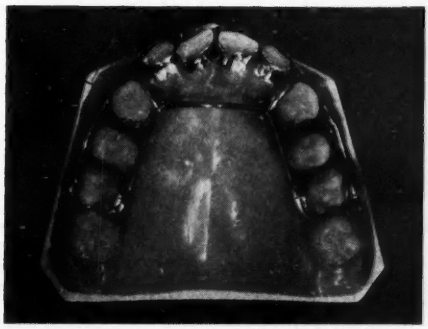
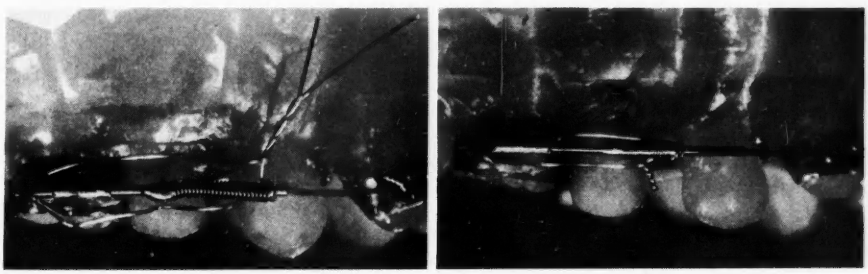


Fig. 5.—Appliance using coil springs for lingual movement of upper incisors by intramaxillary traction.



A B

Fig. 6.—A, Showing how the coil spring is "tied back" against a stop on the end tube. B, The coil spring finally "tied back".

The twin arch is standard with the end tubes as long as possible. Two pieces of coil spring, each about 7·0 mm. long, are placed on the anterior part of the arch. This coil spring is formed from 0·2-mm. wire round a 1·0-mm. core as described by Adams (1957). A stop is fashioned on each end tube about 5·0 mm. in front of the buccal tube. The coil springs are then moved backwards against these stops. The twin arch is inserted in the mouth and the coil spring is "tied back"; a long piece of ligature wire is wrapped twice round the end tube in front of the coil spring as shown in *Fig.* 6 A. The end of the ligature is passed round the protruding end of the end tube and pulled tightly so as to compress the coil spring. The two ends are then twisted together and cut off as shown in *Fig.* 6 B. The coil spring resents this compression and tends to return to its former position. This drives the stop distally and with it the end tube, and this moves the upper incisors lingually. Reciprocal action draws the ligature mesially and this pulls the first molar mesially.

Great care should be used when employing intra-maxillary traction since the buccal segments are usually more ready to come forward than are the incisors to move lingually.

As previously stated, the lower arch may usually be employed for anchorage since the resulting proclination of the lower incisors is

so slight as to be acceptable. If this is not the case some form of extra-oral traction is necessary. It is not easy to apply this to the twin arch owing to the flexibility of the anterior segment. The most satisfactory technique is that described by Bercu Fischer (1952) and shown in *Fig.* 7. A labial bow is constructed

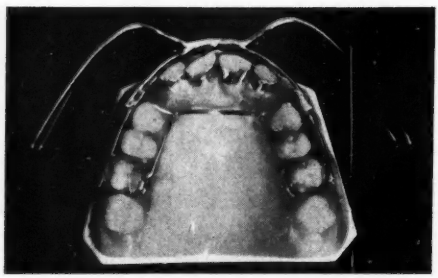
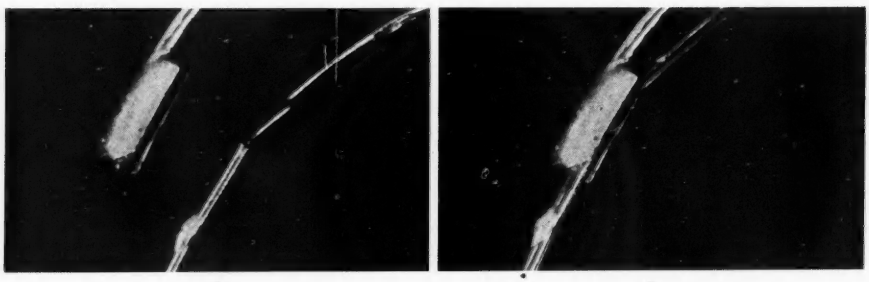


Fig. 7.—Attachment for extra-oral traction to the twin wire arch.

of 1·0-mm. wire to lie just labial to the twin wire with its ends overlapping the end tubes by about 4·0 mm. This is attached to a 1·25-mm. extra-oral bow by soldering opposite the two upper central incisors. A piece of stainless steel tubing about 4·0 mm. long and 1·0 mm. in internal diameter is soldered to the lingual side of each end of this labial bow. The inner side of this tube is then slit longitudinally with a carborundum disk as shown in *Fig.* 8 A. The twin arch is standard except that a stop is placed on the end tubing about 5·0 mm. from its anterior end and well in front of the buccal tube. The twin arch is inserted in the mouth. The extra-oral bow is attached at night by the patient; the slit tubing should be passed sideways over the twin portion and slid distally on to the thicker end tube until it comes into contact with the stop as shown in *Fig.* 8 B. This is done one side at a time by compressing the labial bow slightly, and the patients learn the technique surprisingly easily. The extra-oral bow is then attached by elastic bands to any type of extra-oral anchorage.

THE LABIAL MOVEMENT OF UPPER INCISORS

Individual incisors may be moved labially by merely ligating them to the arch. They will then take up a position in line with the remaining incisors. This technique may be used to move a single incisor over the bite provided that the overbite is only slight. If the overbite is deep, this method will be traumatic unless a lower bite plate is inserted. It would usually be more convenient to use a different type of appliance.



A B

Fig. 8.—Showing how the extra-oral bow is attached to the end tube of the twin arch.

All four incisors may be moved labially by means of a twin arch and this apparatus is particularly useful when there is a minimal overbite. It is, again, not very satisfactory if there is a deep overbite. The twin arch is constructed in the usual fashion but a stop is formed at the extreme anterior end of the end tube. A piece of coil spring 1·0 mm. in internal diameter is placed on the end tube so that it is slightly compressed by the buccal tube when the appliance is inserted. This is shown in

Figs. 9 and 10. The effect of this coil spring is to move the molars distally and reciprocally to move the twin arch and with it the anterior teeth labially. If the distal movement of the molars is undesirable, it may be minimized by the fitting of a lingual arch.

This is particularly useful where the four incisors are inside the bite and overbite is mini-

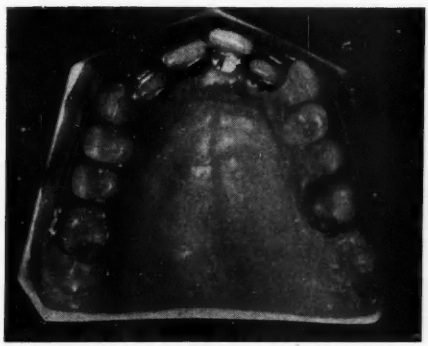


Fig. 9.—Appliance for the labial movement of upper incisors.

mal. If such teeth are moved labially, there is a strong tendency for the overbite to disappear completely with subsequent relapse. In this case, the buccal tubes on the molar bands should be so positioned that they slope downwards towards their anterior ends as shown in *Fig.* 10. When the twin arch is inserted, the anterior part of it, instead of lying along the channels of the ripple brackets, lies about level with the incisal edges of the teeth as shown in *Fig.* 11 A. When the arch is ligated to the teeth, it tends to return to its original position, thus moving the teeth in an incisal direction (*Fig.* 11 B). This counteracts the tendency for the overbite to reduce and enables one to maintain a small existing overbite. The same technique may, of course, be used in an effort to reduce an open bite, although the result is seldom stable.

INCISAL MOVEMENT OF INDIVIDUAL TEETH

A central incisor or a canine which has been surgically exposed will usually move downwards towards the arch without assistance.

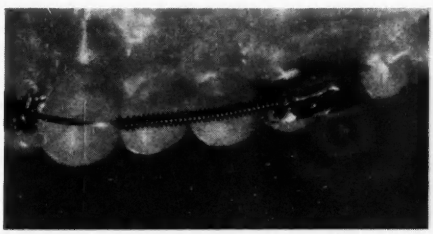
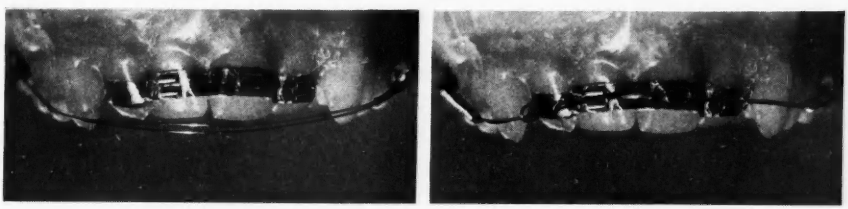


Fig. 10.—Coil spring for labial movement of upper incisors. The buccal tube slopes downwards at its anterior end.



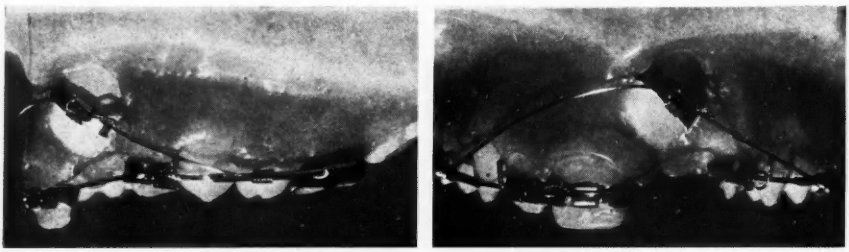
A B

Fig. 11.—A, Passive position of twin arch intended for incisal movement of upper incisors. B, The same activated by ligating to the incisors.

Occasionally, this does not occur and appliance therapy becomes necessary.

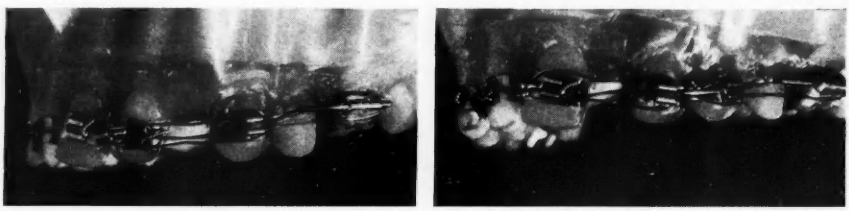
If the tooth is only slightly displaced in the occlusal plane, it may be brought down by ligating only one of the twin wires into the bracket as shown on the upper left lateral incisor in *Fig.* 4. If it is displaced some distance, an auxiliary arch is necessary. This is made from 0·35-mm. hard wire. It is slightly shorter than the twin arch and at each end it is wound into a short coil of six or seven turns and 1·0 mm. internal diameter. These coils lie over the end tubes and can slide freely along them, as shown

in *Fig.* 12 A. The main arch is ligated to the incisors and the auxiliary arch to the bracket on a band on the displaced incisor or canine, as shown in *Fig.* 12 B. This band may be cemented to the tooth at the time of exposure under an anæsthetic and can conveniently be made on a corresponding tooth on the opposite side. The arch exerts a gentle force on the displaced tooth, tending to move it down towards the occlusal plane. As this movement takes place, the auxiliary arch may be ligated to the remaining incisors, commencing with those furthest from the teeth to be moved, thus maintaining a gentle force on the displaced tooth. When the tooth is nearly in line, the auxiliary arch is discarded and the main twin arch ligated to it.



A B

Fig. 12.—A, Side view of auxiliary arch intended for incisal movement of upper incisor. B, Anterior view of the same appliance.



A B

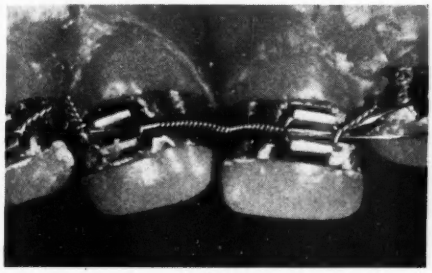
Fig. 13.—A, Appliance for distal movement of $\underline{|^2}$. B, Following retraction of $\underline{|^2}$, the spring is transferred to $\underline{|^1}$.

THE MESIO-DISTAL MOVEMENT OF ANTERIOR TEETH

Individual anterior teeth may be moved mesially or distally along the arch using lengths of coil spring about 4·0 mm. in length. This spring is made from 0·15-mm. wire wound on a 0·5-mm. core.

An example of this technique is shown in *Fig.* 13. In this case the upper centre is displaced to the right and it is desired to correct it. The left first premolar has been extracted and the canine retracted by any of the methods previously described. It is retained in position by a ligature through the bracket and tied back. It is advisable that a lingual arch should be fitted to stabilize the buccal segments and prevent their forward movement. This may carry a spur mesial to the canine to further stabilize this tooth. A 4·0 mm. length of coil spring is placed on the arch mesial to the lateral incisor as shown in *Fig.* 13 A. This may be put on before the twin wire arch is made or with a little ingenuity may be threaded on to the arch after it is complete; it will not pass over the end tubes. A ligature is tied back from this coil spring round the distal of the canine bracket as shown. The tooth will move until the coil spring is passive, when the ligature is

replaced and the spring once again compressed. The reciprocal action is the forward movement of the canine, but this is prevented, since the lateral incisor is pitted against the whole of both upper buccal segments. When the lateral has been fully retracted, it is tied back and the coil spring moved to a position mesial to the upper central incisor as shown in *Fig.* 13 B. The central is moved across in the same way and the process may be continued for each tooth in turn.



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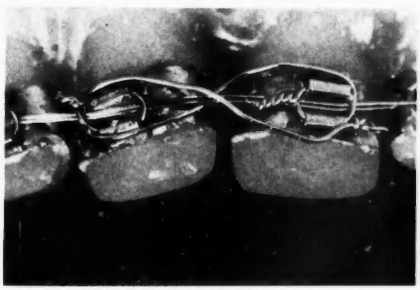

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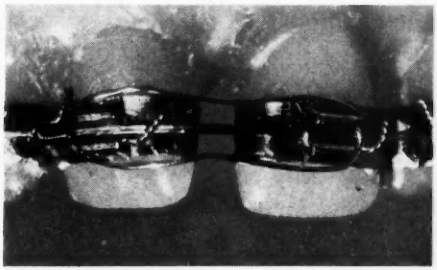

B

Fig. 14.—A, Appliance for reciprocal distal movement of $\frac{1}{1}$. B, Appliance to close median diastema. C, Modification suitable for closing small diastema.

Two incisor teeth which are crowded together and imbricated may be moved apart quite simply by placing a piece of coil spring of the appropriate length on the arch between the two teeth as shown in *Fig.* 14 A. A median diastema may be closed by using a 4·0-mm. length of coil spring which is placed laterally to one of the incisors and tied back round the distal part of the bracket on the opposing central incisors (*Fig.* 14 B). A small median diastema may, in fact, be closed merely by passing a ligature as a figure of eight round the distal of both brackets as shown in *Fig.* 14 C. This ligature should be tightened until the patient is aware of some tightness, but not until pain is produced.

ROTATION OF INCISOR TEETH

The twin arch is an excellent appliance for the rotation of incisor teeth. The length of the bracket is such as to make mesial and distal eyelets unnecessary. If a tooth is grossly rotated, the ligature should only be tightened sufficiently to deform the arch slightly as shown on the upper right lateral incisor in *Fig.* 15. If it is tied right down into the bracket, it will kink the wire and probably loosen the tooth.

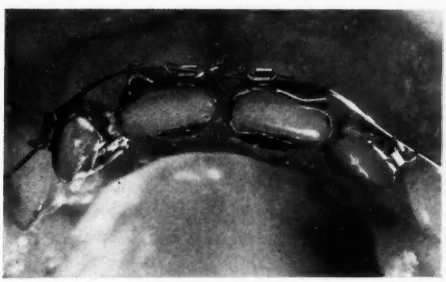

Fig. 15.—Modifications for rotation of upper incisors.

The twin arch will readily rotate a tooth into the line of the labial segment, but it will not produce that degree of over-rotation which is so desirable to prevent relapse. A slight degree

of over-rotation may be achieved by "off-setting" the bracket—that is by placing a small bracket as far distal on a disto-lingually rotated tooth as possible; this is shown on the upper left lateral incisor in *Fig.* 15. Further over-rotation may be achieved if, in addition to this, a protuberance is placed on the opposite end of the labial surface of the band. This is made from stainless steel tape 2·5 mm. wide and 0·25 mm. thick. It may be welded at both ends with the centre part standing away from the bracket as shown on the upper right central incisor. A shallow slit is cut with a carborundum disk in the most labial part of the bracket to accommodate the twin wires. Alternatively, the tape may be welded only at the end nearest to the ripple bracket as shown on the upper left central incisor. The other end of the tape is then curved out from the tooth and grooved to take the twin wire. This later method has the slight advantage that it can be adjusted during use.

Any rotation of teeth and, indeed, most alinement of anterior teeth has a tendency to produce a slight overjet. This is because rotation normally takes place about the centre of the tooth, whereas the most lingual part of the tooth is in contact with the lower incisors. Because of this, lingual pressure should always be held on the incisor teeth in using the twin arch, either with intramaxillary, intermaxillary, or extra-oral traction.

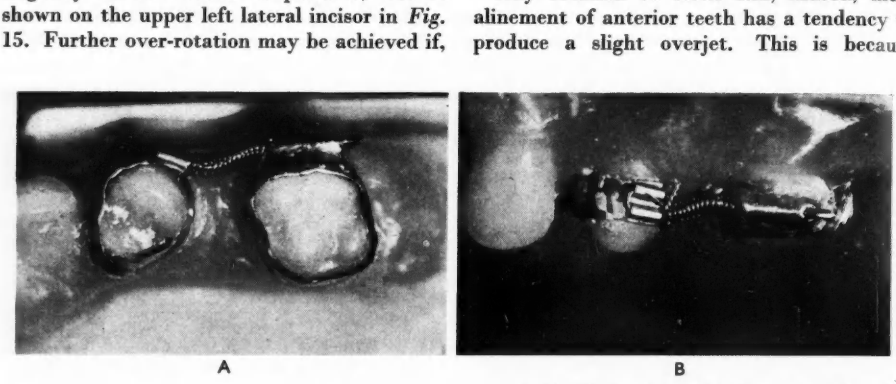

Fig. 16.—A, Occlusal view of the sectional twin arch, for reciprocal movement of $\underline{|46}$. B, Buccal view of the same appliance. C, The component parts of the sectional twin arch.

FINAL ALINEMENT OF ANTERIOR TEETH

In a majority of cases it is desirable finally to aline the teeth by the use of a solid wire. A 0·45-mm. wire, preferably high tensile, is threaded through end tubes and slightly crimped inside them as for the twin wire. This must then be preformed carefully to fit the arch since, unlike the twin wire, it is capable of producing lateral expansion or contraction of the buccal segments. It will position the incisor tooth exactly and it is possible with this to inset the lateral incisors slightly and carry out similar final movements.

MOVEMENT OF POSTERIOR TEETH

Mesial movement of upper cheek teeth to close residual spaces has already been described. Using the twin arch there is a strong tendency

for the upper posterior teeth to tilt mesially and for this reason light forces should be used.

Methods of moving the buccal segments distally have been described by Johnson (1934), Madden (1948), and Townend (1947). These methods undoubtedly work in selected cases, but I personally prefer to use other appliances to achieve this tooth movement.

THE SECTIONAL TWIN ARCH

This is an extreme modification of the twin arch which is very useful in a single instance. This is where, following the loss of a deciduous molar, the first molar has drifted and rotated mesially and the first premolar distally, as shown in *Fig.* 16 A. Slight spacing exists between the canine and the first premolar with impaction of the second premolar. To re-open this space, bands are made for the first molar and the first premolar only. A rather short buccal tube is fixed on the first molar and a ripple bracket on the premolar. Ideally, both of these should be parallel to the true buccal surface of the tooth, but it is necessary to be able to insert a short piece of end tubing into the buccal tube when the appliance is in the mouth. A short piece of end tubing—no longer than the buccal tube on the molar—is taken and a piece of 0·25-mm. wire doubled and the two ends threaded through the end tubing almost as far as possible. The protruding ends are crimped and the double end is drawn back to produce a single-ended twin arch about 12–15 mm. in length. The final article is shown in *Fig.* 16 C and looks not unlike the device sometimes used to thread needles. A piece of coil spring 1 mm. in internal diameter is threaded over the whole sectional arch. The end tube is placed inside the buccal tube in the mouth, the coil spring compressed, and the anterior end ligated to the ripple bracket as shown in *Fig.* 16 B. In doing so, the ligature wire must pass between the two twin wires at the anterior end to prevent them slipping distally out of the ripple bracket. The effect of the coil spring is to push the buccal surface of the two teeth apart, which re-opens the space and simultaneously rotates the tooth. The flexibility of the twin wire permits this rotation to take place.

THE LOWER ARCH

Again there is no doubt that the twin arch can be used successfully on the lower teeth. It is, however, liable to trauma from the occlusion and it is also difficult to make it follow the increased curve of von Spee which is often present. The present auther has completely abandoned its use in the lower arch, preferring to use a light 0·45-mm. round wire such as is shown in *Fig.* 4.

CONCLUSIONS

1. The twin wire arch constitutes a useful compromise between the comparative inaccuracy of the removable appliances and the trauma and fatigue of fully banded techniques.

2. It is most useful for carrying out those movements of the upper incisor teeth which do not involve movement of their apices.

3. It should be regarded as one weapon in our armamentarium and not as a universal appliance.

Acknowledgements.—I would like to acknowledge the assistance I have received over many years from my colleagues at Liverpool, Manchester, and the Eastman Dental Hospitals in showing me many of the modifications I have described. I would also like to thank Mr. D. T. Hartley for the loan of an acrylic model shown in *Fig.* 12, Professor Ballard for encouragement and permission to publish the paper, Mr. Morgan and his staff for taking the photographs, and Miss J. Jeffery for secretarial assistance.

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DISCUSSION

The President thanked Mr. Mills for a valuable and practical paper on the twin-wire mechanism. Many of them would remember when thirteen years or so previously that mechanism became very popular and they used to read in the journals about elaborate and attractive attachments and wonder how they could obtain them. Twin wires had always appealed greatly to orthodontists in this country. The edgewise always had a mystique of its own; it had always had its high priests and apostolic succession! In this country many had been nervous about embarking on its use, but descriptions such as members had just heard enabled them more clearly to understand it. Perhaps some people had rushed in and used it a little too readily. It was a flexible and useful mechanism.

The buccal tubes described by Mr. Mills seemed to be short. He himself had used longer ones in order to steady the end tubes.

The President asked Mr. Mills whether, when he was using intermaxillary traction with retraction coil springs, he measured the relative forces and balanced them off.

Mr. Mills agreed that he used buccal tubes rather shorter than most people's. He used stainless steel tubing and personally found no difficulty with it. He thought that it was very desirable to use tubing which was perfectly round rather than a tube which has been constructed from tape. Mr. Mills agreed that it was desirable to measure the forces used, although he did not always do it.

The President called on Mr. Hartley to open the discussion.

Mr. Hartley said that it gave him great pleasure to open the discussion on the extremely useful and practical paper read by his friend and former colleague.

The deplorable misuse by American confrères of the word "philosophy" found, he trusted, no support in this country. British orthodontists remained sturdily independent in preferring to subordinate the appliance to the malocclusion, rather than attempting to fit all their patients into any single system of treatment.

Mr. Mills's approach to the twin-wire arch as a tooth-moving mechanism was surely the right one, and he had covered with admirable clarity and detail virtually all the possible tooth movements of which this appliance was capable. As these were essentially the result of the mechanical attributes of the appliance it was unlikely that there would be any major differences between operators in their methods of using it. With the exception of the special modifications, notably Mr. Mills's sectional twin arch and the auxiliary arch for a surgically exposed tooth, he found that his personal use of the twin-wire appliance corresponded so closely to Mr. Mills's that they differed only on small points of technique, one or two of which he would illustrate.

The preformed attachments which he preferred were: the twin tie channels to be made in two widths (3 mm. and 2 mm.) to cover the needs of central and lateral incisors. Their great advantage lay in the flange which projected at each end for spot-welding to the band. This made a special knife-edged electrode or welding jig for the centre channel unnecessary. The flanged buccal tube was, in his opinion, a considerable advance on the soldered type described. It was welded to the molar band at the chairside, using the following technique: the buccal surface of the molar band was marked with a small file held closely against the canine and premolars. This indicated the position for correct tangential attachment of the tube on the curved surface of the band. The band was removed and the buccal tube attached by one light weld on the gingival portion of the flange. The band was re-seated on the tooth and a 7-cm. length of end-tubing used as a lever to twist the buccal tube upwards or downwards around the single weld point until the tubing was at the required level anteriorly, when the flanges were firmly welded. The other side of the mouth was dealt with similarly, correct alinement being obtained by setting the second guide-tube at the same level anteriorly as the first.

This direct technique eliminated the need for taking an impression, casting a working model, soldering and polishing; it guaranteed correct alinement of the buccal tubes; and it enabled him to cement the bands and complete the appliance at one appointment if he so wished.

Mr. Mills had referred to the difficulty of keeping soldered intermaxillary hooks in the vertical plane when drawing the twin arch to length. This seemed to be a common problem, but it could be readily solved by grasping the projecting right-angled ends of the twin wires on the affected side and twisting the end-tube round until the hook was in correct alinement. This had been described by Dolce in 1943.

He was a little surprised to hear the distal movement of posterior teeth dismissed so summarily. He had always thought it rather surprising that using the Johnson technique in a Class II case the upper incisors were fully retracted first, leading to crowding of the canines and premolars. Coil springs were then added to move the molars distally, when the premolars followed in most cases. However, if one started by moving the molars back the premolars did not follow and treatment was more complicated. He wondered if Mr. Mills would enlarge on his experience of this?

His second question concerned overbite reduction. He gathered from the literature that this readily occurred during twin-wire technique, but said that this had not been his experience. He said that Madden mentioned that the extraction of premolars made bite-opening very difficult, so perhaps that was the source of his trouble. Could Mr. Mills comment on this point?

Throughout the paper the attention of the members had been drawn to the outstanding springiness of the twin-wire appliance. The extent of this might not always be realized. It was instructive to compare it with a single round wire appliance of the same overall size, similar to that used for final alinement of incisors.

Assuming identical physical properties (although this was not strictly true because of the extra work-hardening received by the finer wire in manufacture), a single 0·25-mm. wire was sixteen times as springy as a 0·5-mm. wire (springiness varies inversely with the fourth power of the diameter). On the other hand, it had only one quarter of the strength (strength varies directly with cross-sectional area). The twin-wire appliance was thus half as strong, but eight times as springy, as the single 0·5-mm. arch.

Nevertheless the long-range automatic action of this appliance was not without its dangers, as the President had just pointed out. In 1953 Moyers and co-workers had reported that during animal experimentation it was found easier to produce root resorption with the twin wire than with any other appliance tested, including the edgewise. He said that there was still no substitute for

the orthodontic skill and clinical experience which had so obviously formed the background to Mr. Mills's excellent paper.

Mr. Mills thanked Mr. Hartley for his remarks. The preformed anterior brackets were, of course, rather expensive. He personally had not found the twin arch very satisfactory for the distal movement of molar teeth. It was difficult to apply extra-oral traction to the appliance. He had attempted to show those tooth movements for which he personally found the twin arch satisfactory, but he realized that others used it for distal movement of the molars.

In the case of a deep overbite, his normal procedure was to retract the canines with a removable appliance which carried a bite plane to reduce the overbite. The twin arch would then be able to move them lingually. If this was not successful, then the incisors were pulled lingually in an effort to slide them up the lower incisors. It had been suggested that this might cause apical resorption, although personally he had not found it.

Mr. G. C. Dickson thanked Mr. Mills for an instructive paper. Regarding sectional twin arch, the slide which had been shown illustrated the premolar fairly well away from the molar. The loss of space was not gross. But it seemed that if the loss of space was at all gross there would be little room to accommodate a sectional arch and spring. Was there an arch to meet that problem?

Mr. Mills said that Mr. Dickson always spotted the weakest point. The sectional twin arch was only really useful where loss of space for the second premolar was moderate. It was particularly useful where there was spacing between the canine and first premolar.

Mr. J. W. Softley thanked Mr. Mills for the paper. He used a multiple arch with four 0·15-mm. wires in the end tubing, which provided a much gentler action than two 0·25-mm. wires, and was much more flexible than a twin arch. In the case of uppers one could use six 0·15-mm. wires in the end tube and tie them right down to much greater malocclusions than was possible with two 0·25-mm. wires.

Mr. Mills remarked that this was one of the many applications of the twin arch which Mr. Softley had shown him many years ago. He had occasionally used it where teeth were very irregular, but found that it was apt to become damaged owing to the thinness of the wires. In the lower arch, he preferred to use a single round arch for the reasons stated above.

Mr. A. J. Walpole Day said there was one question which ought to be asked, more especially for the benefit of newer members. Mr. Mills had shown them very clearly how they could use the arch for distal movement, mesial movement, rotation and occlusive movement, but he had not enlarged on the other movement: that of altering the inclination of roots of teeth where for example there were two incisors with the apices close together and it was desired to get them apart.

Mr. Mills said that he did not find the twin arch very satisfactory for apical movement, but would prefer to use a thicker appliance for this purpose.

Mr. H. G. Watkin said that his main purpose in speaking was to congratulate Mr. Mills and to say how much he had enjoyed listening to the paper, which was very well illustrated. It was, of course, necessary to have the right pliers in dealing with a particular appliance. He personally preferred the pin-and-tube appliance.

Mr. Mills said that Mr. Watkin had taught him the pin and tube appliance many years ago, and he had used it ever since. Unlike the twin arch, it would produce apical movement. It was rather open to abuse, but, if used properly, had a very definite place in our armamentarium. He was opposed to any appliance being regarded as a universal appliance.

Mr. J. H. Gardiner said he would like to add his congratulations to those already received by Mr. Mills for his clear paper. In the case of more violent patients, had he found that the buccal tubes pulled away from the band when they were purely soldered to the band?

Mr. Mills agreed that people had encountered difficulty in soldering stainless steel. The technique was difficult but, once mastered, there was little trouble. Many people welded tape around the tube to reinforce the soldered joint.

Mr. H. G. Watkin said that he used to solder tubes to bands but the join never remained. In his opinion soldering was no good. He welded a semicircular tube with tabs on to a band and then used a No. 2 drill to make the circle of the tube complete. The join never became unwelded and the teeth were never harmed. The drill helped to make a nice fit and the wire slipped in comfortably and without trouble.

The President said the Secretary was collecting material for demonstrations at next year's meeting and the device just referred to might be very useful in that connexion.

Mr. D. T. Hartley said that the occasional failure of soldered joints in the mouth was probably the result of stress corrosion at the interface of solder and stainless steel. While poor technique might well be partially responsible there were probably other factors involved, for example, the composition of the solder.

Mr. Norman Gray thanked Mr. Mills for his paper, which was packed with valuable information for those who use the twin-arch technique. The more one uses the twin arch, the more one will appreciate the points which Mr. Mills had raised. It was rather difficult to criticize the paper because it was so accurate. Mr. Gray would like to ask Mr. Mills one question about rotated upper incisors. Had he ever used just an anterior section of twin-wire arch using banded incisors alone, sometimes even in conjunction with an over-riding removable appliance?

Mr. Mills said he had not tried that. He had been hoping the discussion would bring forward suggestions from other people, and that was one he would certainly try out.

Mr. J. Angelman congratulated the author and said he was in the happy position of seeing some of his work and some of its excellent results. It might be opportune to remind Mr. Mills of a modification which had not been mentioned: the intermaxillary hooks were extended and small tubes were added to them on which there were U-attachments which were slid on and off by the child, and fixed on by elastics to a headgear. That modification was very simple to use; but he did not think it a very good appliance for rotations. Certainly in his hands a fixed appliance was less efficacious when one came to think of rotations. The soldering of stainless steel was extremely difficult and welded attachments and buccal tubes were far more efficacious.

Mr. Mills said that Mr. Angelmann had inherited a lot of his former patients, and the device referred to was one which he had now discarded. He had described it fully in the DENTAL PRACTITIONER, 7, 208.

He would repeat that he found the soldering of stainless steel quite satisfactory once the technique was mastered. It was important to use a lot of flux and to heat the wire to red heat quickly and then to remove the

flame before the whole area became oxidized. He felt that many people were afraid of heating wire and blackened it without melting the solder.

Mr. F. K. Johnson complimented Mr. Mills upon the paper, and said the appliance had one or two disadvantages. First, it was not easy to keep it clean. When a patient was seen it was usually necessary to remove the remains of the last meal. Then there was difficulty in tucking away the ligatures. They sometimes got dislodged and caused ulceration. Was there any foolproof way of disposing of the ligatures in the twin arch?

Mr. Mills said that all fixed appliances were potentially dirty, as indeed were removable ones. It was possible to keep the appliance clean, and he felt that orthodontists were entitled to some co-operation from their patients. The ends of ligatures he tucked down under the twin wire with a plastic instrument. If they worked loose, the patient could protect the soft tissues by placing a small piece of cotton-wool over the sharp wire until he could attend for repairs.

The President said he felt the discussion had indicated how well the paper was received and enjoyed. He thanked all those who had contributed to the discussion, particularly Mr. Hartley for opening it, and again thanked Mr. Mills for a paper which all of them much appreciated.

ABSTRACTS FROM OTHER JOURNALS

Thumb-sucking

A girl aged 5½ years sucks her thumb so persistently that her lower permanent incisors are displaced. Is a permanent deformity likely to result? What is the psychological significance of the habit?

At 5½ years the lower permanent incisors are just erupting. Despite quite marked displacement there may be no permanent deformity. Orthodontists do not view the habit of thumb-sucking in such a serious light as hitherto. They believe that it is rarely the primary cause of a permanent deformity. The important point is that if thumb-sucking is superimposed as a temporary feature on a dentition which is developing normally, the tongue will re-position the teeth when the habit ceases. The frequency and persistency of the habit have to be taken into account. If the habit is continued for several years, and the deformity is marked, it will not be corrected naturally if the lower lip adopts a position between the upper and lower incisors. Most children will give up the habit by 8 or 10 years of age, with a little help and persuasion. A simple dental plate may be of value; by insulating the palate it removes the pleasure of sucking. No drastic steps need be taken and a nagging parent makes matters worse.

A sucking habit may well be superimposed on a dentition which is developing abnormally owing primarily to inherited jaw form or to adverse tongue and lip forces. The sucking habit may exaggerate the deformity and only minor natural improvement occurs when the habit ceases.

Persistent thumb-sucking in a child of school age to the extent of being held responsible for displacement of teeth is an indication of a need to cling to a form of satisfaction which is normal at an earlier stage of development but which should no longer be appropriate. Such a failure in emotional development, or regression to an earlier stage of development, is indicative of anxiety which may be due to difficulties within the child (e.g., learning problems related to the commencing school situation) or to disturbances of one sort or another in family relationships. It is not only useless to try to stop the symptom forcibly, but it is likely to be positively harmful to future emotional development if its significance is not assessed before treatment is planned. If the thumb-sucking is considered after investigation to have ceased to be significant in itself and to have passed into the realm of "habit" its removal can be facilitated only by the provision of alternative oral satisfactions—for example, sucking or chewing sweets. But every effort should be made to assess fundamental problems before treating persistent thumb-sucking as a habit of little or no emotional significance.—MANDIWALL, M. (1959), *Brit. med. J.*, **2**, 25.

Orthodontic Relapses analysed in a Study of Connective Tissue

An argument is presented to show that connective tissue fibres surrounding teeth and not attached to the bone may be the cause of relapse. Experimental data are presented and investigations are continuing.—THOMPSON, H. E. (1959), *Amer. J. Orthodont.*, **45**, 93.